THE NEW MAN AT THE HELM

On August 26, 1927, the Board of Regents of the University of the Philippines appointed Dr. B. M. Gonzalez acting dean of the College of Agriculture. This action raised to the position of leadership a man who has literally grown up with the institution. Acting Dean Gonzalez first came to this College, with advanced credits from the Philippine Normal School, as a "freshie" seventeen years ago, when Dean Copeland and his handful of faculty members and students were just beginning to carve a college of agriculture "out of wilderness," and graduated three years later. Mr. Gonzalez was subsequently taken on the faculty as assistant in animal husbandry, then promoted to instructorship in 1916, to assistant professorship in 1917, to associate professorship in 1919, and to full professorship in 1920. He was sent twice by the University as a fellow to pursue advanced training in the United States, first from 1914 to 1916, with residence in the University of Wisconsin, where he obtained the degree of master of science and subsequently from 1921 to 1923, at the end of which period he returned to Los Baños with a doctorate of science from Johns Hopkins University. In 1926 he was sent to Japan as one of the delegates from the University of the Philippines to the third Pan-Pacific Science Congress.

Although formally designated head of the Department of Animal Husbandry in 1924, Doctor Gonzalez had virtually been directing this department since 1916. Its present equipment, technical personnel, and highly developed organization, which make Animal Husbandry rank as one of the three largest and most important departments of the College of Agriculture were built up largely through his efforts.

Even in his student days he was engaged in many extra-curricular activities at the College. He held a number of positions of responsibility and trust in the Student Body Organization. He was business manager of The Philippine Agriculturist and Forester for many years. As a faculty member he was often intrusted by Dean Copeland and Dean Baker with the performance of difficult, and not infrequently delicate, missions and committee work. As indicative of his leadership among his associates, he was elected the first alumni regent of the University, from 1918 to 1921;

and was the first president of the College of Agriculture Alumni Association and also of the Los Baños Biological Club. He has been vice-president of the Philippine Society of Technical Agriculturists and secretary of the Philippine Agricultural Congress.

Doctor Gonzalez has travelled very extensively, and has visited many institutions having to do with agricultural education in Europe, the United States, and Japan. Although comparatively a young man (only thirty-four), he has now to his credit about thirty scientific papers. He has always stood for service and a high degree of scholarship.

WHAT ARE YOUR ANSWERS—YES OR NO

Agriculture (New Jersey) offers the following questionnaire to farmers:

For success, the farmers of today have found it necessary to consider the following questions:

Have I carefully saved and used all the manure that has been produced on the place?

Have I followed the practice of having seed tested for purity and germination?

Has my land always been thoroughly prepared so that the seed has a fair chance for germination?

Have I given sufficient study to the problems of farm drainage and crop rotation?

Have I estimated how much I might have saved had I put into practice well-known methods of controlling insect and fungous diseases?

Have I been as careful as I might have been in the matter of neatness, and quality and quantity in putting up packages of fruits and vegetables for the market?

Have I studied the fertilizer requirements of my soil with particular reference to the crops that I am growing?

Have I squarely faced the fact that it is contrary to the laws of nature to take from an acre of land, for a period of 20 to 40 years, more plant food than I return to it, if I would have my yields increase rather than decrease?

The farmers who study these questions the most carefully, and act accordingly, are the farmers who survive and succeed.

SCIENCE AS CULTURE

Reprinted from *Science*

The time when a knowledge of the Greek and Roman classics was the hallmark of an educated man has past. To-day, even their cultural value is fast diminishing. To know Eros is nowadays not so important as to know what Freud believes about love. The fire Prometheus stole is less use to us than the energy generated by photosynthesis. Phoebus's chariot has become an internal combustion engine; radio replaces Mercury; the metamorphosis of cellulose into rayon, lacquers, celluloid, artificial leather, explosives and what not transcends the myths told by Ovid. Chemistry, physics and biology are to-day not only "a systematized and co-ordinated body of facts," they are also the tools and the toys of the man on the street. They are at once the subject of erudite monographs by specialists and of common gossip around the tea table. Their laws govern the operation of our factories; their principles are applied in the kitchen; their technical terms have become newspaper jargon. In the marketplace or by his own fireside a man is deaf, dumb and blind without at least a working knowledge of the sciences. They are, as Br'er Rabbit said, "de mos' kulturines' t'ing in de world".—WILLIAM HAYNES.

HONORS

He came to Cornell alone—he went home alone. He came to Cornell a fragile weakbodied individual and went home the same. After four years he had never done anything outside of class-work, not even skating or tobogganing. He knew two students, his roommate and his brother. He was acquainted with three professors, his faculty adviser and two others he had taken work under. But he jangled two honorary keys from his watch chain. They were his reward for four years of sacrifice for mere knowledge, of his time, his money, his health, his pleasure, and his biggest opportunity, to gain experience and to build friendships.

—*The Cornell Countryman.*

METHUSELAH

Methuselah ate what he found on his plate
And never, as people do now,
Did he note the amount of the calorie count—
He ate it because it was chow.

He wasn't disturbed as at dinner he sat
Destroying a roast or pie,
To think it was lacking in granular fat
Or a couple of vitamins shy.

He cheerfully chewed every species of food,
Untroubled by worries or fears
Lest his health might be hurt by some fancy dessert,
And he lived over nine hundred years!

—*Medical Sentinel.*

—From *The Kalends of the Waverly Press* (U.S.A.).

EDUCATION AND AGRICULTURAL PROMOTION IN JAPAN: V. STOCK RAISING[1]

B. M. GONZALEZ

Delegate from the University of the Philippines and the Government of the Philippine Islands to the Third Pan-Pacific Science Congress

WITH NINE TEXT FIGURES FROM PHOTOGRAPHS BY AUTHOR

Stock raising is not a Japanese industry of long standing. In the very early centuries of the Empire, farm animals were raised to some extent, but with the spread of Buddhism and Shintoism the use of animal flesh for human consumption became taboo, and later, economic changes decreased the use of animals in agriculture. With the advent of Western influence, however, the bars of religion have gradually been let down and each year shows an increase in the meat consumption of Japan.

The development of stock raising in Japan is permeated with patriotic influence. In the first place, the consumption of meat was stimulated by the belief that the white men of the Occident who opened the doors of Japan to the world trade acquired their size, valor, and enterprise because meat was a part of their diet, and that if the Japanese desired to become as progressive and vigorous they would have to consume animal flesh. They were told that Japanese remained small because they did not eat meat. In their patriotic fervor to hold their own among the peoples of the world the Japanese began to include meat in their diet in spite of their religious teachings.

Horses

The original horse of Japan was of Mongolian extraction with admixture of Persian blood. It was a relatively coarse big-boned animal a size larger than the Philippine pony. Horses are used for riding and to a limited extent by farmers for draft and as pack animals. At the present time the greater part of the horses are raised in northern Honshu and Hokkaido where the land holdings are relatively large.

During the Boxer trouble in China in 1899, when the army of Japan came in close contact with Western armies, and during the Russo-Japanese war in 1904-05, the Japanese mounts being small, rough, and unruly showed up very badly in comparison with those of other nations. This aroused the authorities to the need of rapidly improving the stock, and in 1906 a Horse Bureau was established[2] to effect intensively the improvement of the stock.

[1] General contribution from the College of Agriculture No. 190.

[2] Takenobu, Y. The Japan Year Book, 1926. Year Book Office, Tokyo.

The program called for the placing of 1,500 stallions of foreign breeds for public breeding with the native stock, and an outlay of about 30 million yen to be spent in 28 years.

The government had realized some years before this comparison of military mounts the necessity of improving the horse stock and had in 1895 appointed a commission to study the best means of effecting this.[3] The commission recommended the acquisition of promising breeds from different countries and the establishment of stud farms wherein the breeding of stallions of foreign blood might be carried on. Two such farms were established, one in Cichinohe, Aomori prefecture, and the other in Hidaka, Hok-

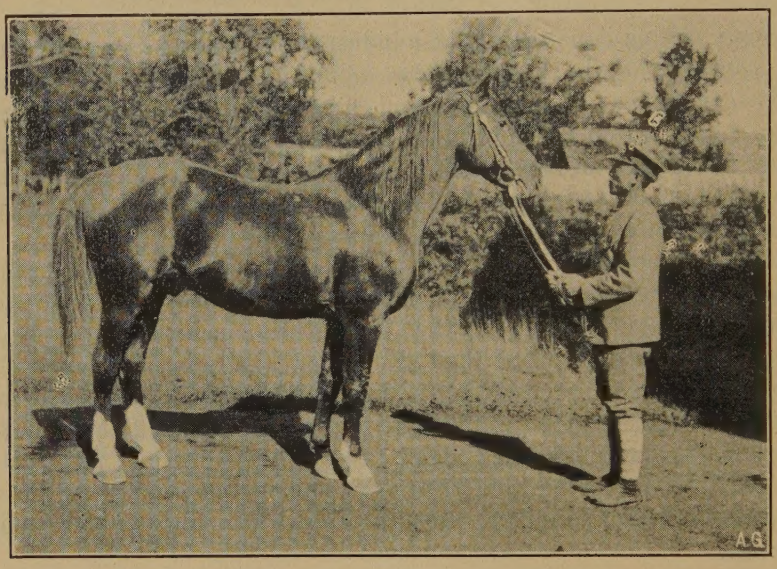

Fig. 1.—O–bajan V-b, an imported Arabian stallion at the O-u National Stud Farm. He cost the government 6,000 Kronen, or ₱2,500. Other stallions range in price up to ₱65,000.

kaido prefecture. Stallion depots or public breeding stations were then to be established in horse breeding centers scattered over the country. There are now twelve such depots.

To give an idea of how the project is carried on, the O-u Stud Farm, which the writer visited, is here described in some detail.

The O-u stud farm was formally established in June 1894[4] under the Department of Agriculture and Commerce. The farm covers an area of 2,235 hectares and is situated west of Cichinohe town in Aomori prefecture. About one-half the area is rolling land, and the other half an extensive

[3] Yamawaki. Japan at the beginning of the 20th century. Volume of information prepared for the Louisiana Purchase Exposition at St. Louis, Mo., 1904.

[4] Ban, T. The O-u stud farm. Unpublished manuscript specially prepared for the writer.

plain. The climate is cool in summer and rather cold in winter, reaching to as low as 16° C. below zero. The farm is devoted exclusively to the breeding of light horses and serves as one of the feeder stations to the stallion depots. At the time of the writer's visit the following animals were kept:

BREED	BREEDING STALLIONS	BREEDING MARES	4-YEAR OLDS		3-YEAR OLDS		2-YEAR OLDS		YEARLINGS		BELOW 1 YEAR		TOTAL
			M	F	M	F	M	F	M	F	M	F	
Arabians	2	8	—	—	—	1	—	1	—	7	2	2	23
English Thoroughbreds	3	9	—	2	—	—	—	2	3	1	3	4	27
Anglo-Arabs	—	21	—	—	—	2	—	3	8	6	6	4	50
Anglo-Normans	3	54	—	—	—	4	—	11	20	14	15	8	129
Half-breeds	—	34	—	—	—	5	—	4	5	16	7	6	77
Crossbreeds	—	—	—	—	—	—	—	—	—	—	—	1	1
Total	8	126	—	2	—	12	—	21	36	44	33	25	307

The sole function of the farm is to raise breeding animals. The rate of increase has been observed to range from 60 to 70 per cent of the mares kept. Two year old stallions are sent to the National Stallion Rearing Farm at Morioka, Iwate prefecture, for training. The best stallions are kept by the government for use at the public breeding stations. The best mares are retained for breeding in the farm; 70 to 80 per cent of stallions and mares are thus retained. The discarded ones are sold to the public.

The National Stud Farm at Hidaka, Hokkaido, is a station similar in purpose and extent of operation to the O-u stud farm. It also sends its stallions for training to the rearing farm at Morioka.

Stallion depots. There are twelve stallion depots maintained: in Tokachi and Osamambe, in Hokkaido Island; in Aomori, Akita, Iwate, Miyagi, Fukushima, Nagano and Shimane in Honshu Island; and in Kumamoto, Miyazaki, and Kagoshima in Kyushu Island. The specific function of these stations is to maintain stallions for public breeding.

In the early years of the work of horse improvement two experts were sent abroad every year for the sole object of selecting and purchasing breeding horses. These men visited the different countries of the world wherein good horses were likely to be obtainable. Through this work England, France, and Arabia contributed blood to the horse breeding program of Japan. Neither expense nor effort was spared to insure the success of the enterprise.

The following stallions at the O-u Stud Farm were all purchased abroad:

Name	*Breed*	*Origin*	*Price*
Gallon	Thoroughbred	England	£ 2,400
Rushcutter	Thoroughbred	England	£ 2,500
Roidcur	Thoroughbred	England	£ 6,500
O'bajan V-b	Arabian	Hungary	K. 6,000
Wagih	Arabian	Syria	£ 1,135
Saumur	Anglo-Norman	France	Fr. 15,000
Tyrol	Anglo-Norman	France	Fr. 18,000
Filankator	Anglo-Norman	France	Fr. 18,000

How effective the program of horse improvement embarked upon by the Japanese government has been may be judged by the fact that one has great difficulty now in finding a pure native horse. In all his travels in Japan the writer saw only one horse that was apparently of unmixed parentage (see fig. 2). Practically all horses of Japan are now grades of recognized breeds, such as Arabian, Thoroughbred, Standard-bred, Anglo-Norman, Hackney, Clydesdale, etc. Draft breeds have apparently not been as popular in Japan as the light breeds. Good horses are to be found everywhere, so that the Japanese Army is no longer at a disadvantage in so far as mounts

Fig. 2.—A native horse of Japan. It is a big-boned coarse animal, now rarely seen except in isolated districts.

are concerned. Takenobu[5] states that the army purchases in the open market from four to five thousand horses every year. The average height of the original horse was 4 feet, while at present the average height is 5 feet 2 inches.

A law which aids greatly in improving the horse stock is the compulsory castration of inferior animals. Owners are reimbursed for a part of the cost of the animals disabled or that die as a result of the operation.

Horse racing is a subsidized pastime in Japan with the object of encouraging the breeding of good horses and to develop horsemanship as a healthy sport. Betting is allowed under government supervision. Ten race tracks are in operation.

[5] Takenobu, Y. *loc. cit.*

The usual feeds given to horses in Japan are oats, soybeans, rice bran, carrots, and timothy hay.

Japan had 1,568,685 horses in 1924.

The number of stallions qualified for public service during the same year were:

Foreign, bred locally	2,323
Foreign, imported	602
Grades	2,385
Native	32
Total	5,342

Cattle[6]

The native cattle of Japan are largely of Korean extraction with admixture of Chinese blood. The predominant color of Japanese cattle is

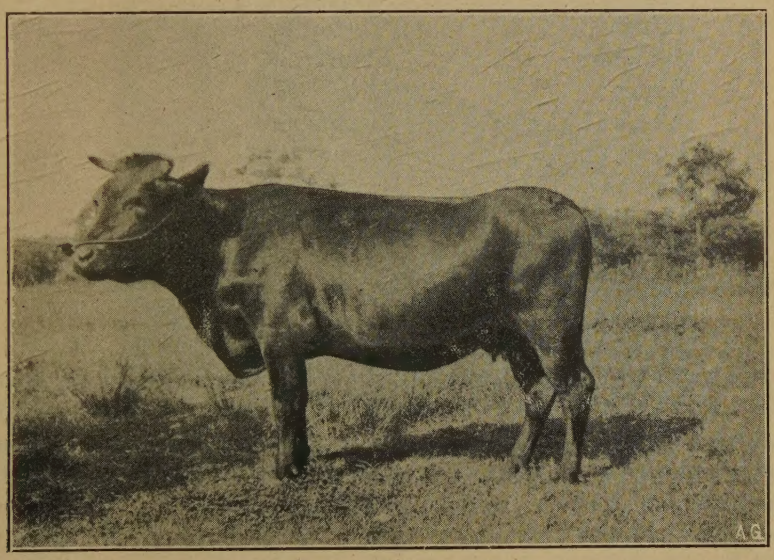

Fig. 3.—A common ox of Japan. It is black in color. Its meat is held in high esteem by the Japanese, who consider it superior to that of foreign breeds.

black. Korean cattle are still being imported into Japan and may be encountered as draft animals in the cities as well as in the country. They are reddish brown in color. The principal animals used for plowing by the farmers in the southern part of Honshu and in Kyushu Island are Korean oxen. The usual practice of the farmers is to buy oxen when the planting

[6] Abstracted largely from: "The present condition of cattle farming in Japan." Department of Agriculture and Commerce of Japan in Proceedings of the Scottish Cattle Breeding Conference, 1925. Oliver and Boyd: Edinburgh.

season is approaching, use them for plowing, then fatten them and sell them when the work is over. There are farmers who repeat this procedure as often as three times a year. From forty to fifty thousand Korean cattle are imported into Japan yearly.

The proportion of draft cattle fattened and slaughtered for beef is about 65 per cent. The dressing percentage of such cattle is found to be about 49 per cent.

Cows are kept until they are five to eight years old before they are slaughtered.

European breeds of cattle have been imported extensively in Japan, and with their help, in a number of regions, local breeds have been developed particularly adapted to the locality. These breeds are dual purpose, for work and beef. A number of such breeds and the prefectures where they are raised follows:

Breed	*Prefecture*
Inpaku	Tottori
Shimane	Shimane
Bungo	Oita
Akage-Higo	Kumamoto
Bocho	Yamaguchi
Tajima	Hyogo
Jinseki	Hiroshima
Chiya	Okayama

Japan had 1,456,243 cattle in 1924, and 60,825 dairy cows.[7]

Dairying

Foreigners living in the principal trade centers have created a demand for milk. Foreign breeds, such as Devon and Shorthorn, were imported for this purpose at first. Later, Holsteins, Ayrshires, and Jerseys were brought in in large numbers. Representatives of practically all breeds have been brought in at one time or another, including Simmenthals, Brown Swiss, Guernseys, and French Canadians. While the Department of Agriculture initiated the importation of dairy breeds, individuals later took hold of it and of late private importations have been very frequent. The government encourages the bringing in of high class breeding stock by remitting the import duties on such animals as pass inspection. This duty amounts to ten per cent *ad valorem*.

Of all imported breeds in Japan, Holsteins are now the most numerous. This is because they are heavier yielders than other breeds and are therefore preferred. Ayrshires come next in number. They have the reputation of being hardier than the Holsteins and their calves easier to raise. The

[7] Section of statistics. 1926. The statistical abstract, Department of Agriculture and Forestry. Tokyo, Japan.

United States is the usual source of improved dairy stock, although occasional animals come direct from Canada, Australia, and Holland.

The dairy industry of Japan was greatly stimulated during the World War. Condenseries were established in many places, thus affording an outlet for the milk produced. There were at the time of the writer's visit, October 1926, twenty-two condenseries. The largest ones were in Hokkaido; and a number of smaller ones were in the prefectures close to Tokyo.

There are only a few creameries in Japan, for the demand for butter is limited to the larger cities wherein foreigners reside.

As pointed out in a previous article,[8] Japanese land holdings are very small, and dairy farms, while considerably larger than the usual farm, are no exception. In Hokkaido, where the farms are larger than in the mainland, the average holding of the dairymen around Sapporo is five hectares, and they keep three to four cows on that.

Fig. 4.—The first and only co-operative creamery in Japan. It is run by a graduate of an American university. Near Sapporo, Hokkaido.

The average yield per cow in 1922 was 3912 pounds (1774.4 kgm.). The average yield of 110 Holsteins registered at the Central Association of Animal Industry is as follows:

Milk	16,827.7 lb.	(7632.5 kgm.)
Fat	613.7 lb.	(278.4 kgm.)

It is claimed that two cows of Japan have beat the world's record for milk and butter fat production which has been held by the recognized world's champion dairy cow, Melba 15th of Darbalara, an Australian-

[8] Gonzalez, B. M. 1927. Education and agricultural promotion in Japan: IV. Promotion of agriculture. The Philippine Agriculturist **14**: 67–71.

bred Shorthorn, which produced in a 12-month period 32,522 pounds (14,751.7 kgm.) of milk yielding 1614 pounds (732.2 kgm.) of butter fat.[9] These Japanese champions are Holstein cows: Frins Anna Roland with a record of 37,923.3 pounds (17,201.5 kgm.) of milk with 1827.1 pounds (828.8 kgm.) butter fat and Ellen Pietertje Granson with a record of 41,112.6 pounds (18,684.3 kgm.) of milk and 1,793.1 pounds (813.3 kgm.) of butter fat.

The usual feeds given to dairy cattle are: soybean cake, crushed oats, imported wheat bran, malt sprouts, linseed meal, green pea meal, beet pulp, and silage of corn and *Astragalus sinicus*.

In addition to the exemption from import duty of superior breeding cattle, the government attempts to encourage cattle farming in other ways. Bulls standing for service are first inspected and licensed. The certificate is good for only one year, except when the animal is exceptionally good, when it may be issued for three years. In 1922, 6292 bulls were thus licensed. They were of the following breeds:

Native breeds	3,443
Korean	78
Holstein	1,851
Holstein grades	355
Ayrshire	189
Ayrshire grades	14
Shorthorn	84
Shorthorn grades	130
Other pure breeds	40
Other grades	108
Total	6,292

The government also grants prize money and medals for live stock shows and subsidizes breeders associations maintaining herd books of pure breeds. At present herdbooks for the Holstein, Ayrshire, and Jersey breeds are maintained. It is also proposed to open herd books for native dual purpose breeds of work and beef.

Swine

The Japanese have not included pork in their dietary to the extent that they have beef; in fact it is eaten very seldom. Because of this, hog raising is not popular, although it could be. In a country where rice is the staple the amount of rice bran produced must be considerable, and this can well be the basic feed in hog rations. As it is, considerable amounts of rice bran are turned back to the land direct in the form of fertilizer.

In some of the prefectures of the south, which, due to proximity, have long had constant trade relations with Korea and China, the consumption of pork is more general.

[9] Sanders, A. H. 1925. The taurine world. The National Geographic Magazine 8: 591–710.

The government has not neglected the promotion of the hog industry, although it has not done as much for it as it has for other live stock. Improved breeds are maintained on the government stock farms, as the Zoötechnical Experiment Station in Chiba, and Makomanai Cattle Breeding Station near Sapporo. The breeds represented are Yorkshire, Berkshire, Duroc Jersey, and Poland China—all coming from America.

A swine product which has gained merited favor is Kamakura ham. This is a mild sugar cured ham. A greater part of the product is exported to China.

Fig. 5.—Swine yards at the Imperial Zoötechnical Experiment Station, Chiba. Members of the Station staff in the foreground.

Poultry

Chickens are kept in small numbers on farms and around village homes. It may be said that specialized poultry farms are not to be found. The government has stimulated poultry raising by imposing a heavy tariff on imported eggs. At first this was ten per cent, then it was raised to twenty, and now stands at fifty. Formerly, Japan imported large quantities of eggs from China, but through the operation of the tariff this has decreased considerably.

One is astonished to find how common imported breeds of fowls are, especially White Leghorns and Barred Plymouth Rocks. There are also

some Rhode Island Reds, Black Minorcas, and Brown Leghorns. In 1925 the number of birds was as follows:

Breed	*Number*	*Per cent*
White Leghorn	8,028,700	22.5
Nagoya	7,796,200	21.8
Barred Plymouth Rock	1,447,700	4.1
Black Minorca	819,400	2.3
Brown Leghorn	550,000	1.5
Crossbreeds	13,865,100	38.8
Others	3,231,500	9.0
Totals	35,738,600	100.0

For the most part, the foreign breeds were imported from the United States. The Nagoya is the common native fowl of Japan. It is buff in color with black or dark slate shanks. It is a large bird but late maturing. The writer brought some eggs of this fowl from the Imperial Zoötechnical Experiment Station at Chiba to the College. They are being tested for the adaptability of the breed to the Philippines.

SHEEP

This is the latest stock industry that has received government stimulation. Great difficulty was experienced during the World War in getting a steady supply of wool for the use of the country and the army. The government realized the necessity of providing a home supply of this important product, and accordingly in 1918, 330,000 yen was voted by the Diet for the purchase of breeding sheep in Australia, England, America, etc.[10] Most of these sheep were kept in government stations for propagation; a few were turned over to farmers direct. A farmer raising sheep is given a subsidy of five yen per head of sheep kept on his farm. Since 1919 an appropriation of 460,000 yen has been set aside every year for the importation of 1000 head of breeding sheep.

Two sheep breeding farms were established in Hokkaido for the purpose of furnishing breeding stock to the farmers in the future. One of these is here described in detail.

The Tsukisappu Sheep Breeding Station. This station was established in 1923 and is located a few miles out of Sapporo. The farm has an area of about 1500 hectares and is devoted exclusively to the raising of sheep. The following animals have been imported and are at present raised on the farm:

Breed	*Origin*	*Number*
Rambouillet	America	719
Corriedale	Australia	542
Merino	Australia	176
Ost-Friesian (milch)	Germany	133
Romney Marsh	England	81
Romanovski (wool)	Russia	37
Shropshire	England	34
Cheviot	England	22
Southdown	England	3
Crossbreeds		34
Total		1,701

[10] Takenobu, Y. *loc. cit.*

The station has an annual appropriation of about 110,000 yen.

The feeds used for the sheep are wheat bran, crushed oats, pea meal, pumpkins, and pasturage. The different breeds of sheep are kept separate in sixteen barns. A station similar to this one in importance and extent of operations is maintained in Takikawa, Hokkaido.

This is not the first time that Japan has attempted to raise sheep. The earlier attempts were on a minor scale, however, and failed on account of the prevalence of disease. A provision is now made for regular veteri-

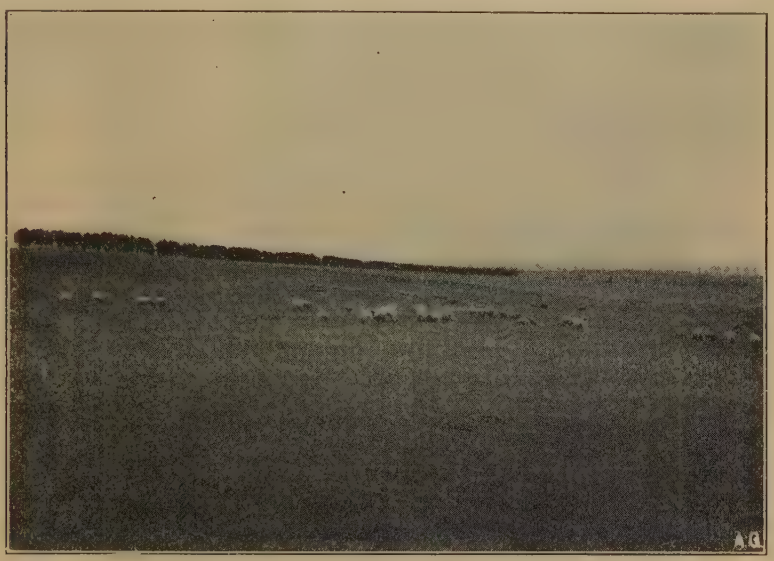

Fig. 6.—Imported sheep at the National Sheep Farm, Tsukisappu, Hokkaido.

nary inspection of flocks at government expense. It is evident that no efforts are spared to establish the sheep industry in the country. The government spends annually approximately one million yen for the development of sheep raising.

The progress being made may be roughly judged by these figures:

Number of sheep in Japan

1914	2,771
1915	2,768
1916	3,370
1917	3,192
1918	4,546
1919	4,683
1920	8,519
1921	9,741
1922	11,384
1923	14,950
1924	15,710

The year 1919 marks the period when the government took definite steps to establish the sheep industry in the country.

In talking over the sheep situation with a number of Japanese, the writer found many who were skeptical as to the outcome of the government efforts. Knowing what has been accomplished with other live stock industries and knowing the patriotic zeal of the people, the success of the enterprise seems assured. It is true that the small-sized farm holdings are not well adapted to sheep raising, but so long as no fundamental difficulty, as unfavorable climate, exists in certain regions, it seems perfectly possible for farms in these places to so adjust their operations as to include sheep. As the sheep enter into direct competition with other animals and with crops that are likely to be more profitable, it may be necessary to continue the government subsidy indefinitely. There is already one breeder who has 300 head at Nemuro, but the small farmers keep only four or five head.

Fig. 7.—Cattle barn in Hokkaido. The type of farming in this northern island of Japan is American, adopted largely from Wisconsin's dairy farms.

THE IMPERIAL ZOÖTECHNICAL EXPERIMENT STATION

Worthy of mention in connection with the development of the live stock industry of Japan is the Imperial Zoötechnical Experiment Station at Chiba. A few notes from the prospectus of the station follow:

In 1900 a cattle breeding farm was established at Nanatsukahara, Hiroshima prefecture, for the purpose of improving the native breeds of cattle. The program was to import British and Swiss breeds of cattle, propagate them, and distribute bulls for the grading up of the common stock.

By 1910 three other stations of a similar nature were established in other parts of the country and they included in their work, besides cattle, swine, goats, and poultry. In 1916 the government realized the need of a research institution to solve, definitely, problems of the live stock industry rather than to just produce animals for breeding purposes. To fill this

need the Imperial Zoötechnical Experiment Station was established. The four cattle breeding stations were converted into branch stations. Later, in 1924, all the branch stations were closed because of financial stringency.

The station as it exists at present has an area of 65 hectares, more than half of which is under cultivation. It has 157 buildings and enjoys a yearly appropriation of 300,000 yen. In addition to doing research work, it distributes improved breeding stock to the public by sale, or by loan to accredited associations. It also takes a limited number of students for training in the technique of manufacturing dairy and meat products. The work is divided into four divisions: animal husbandry, poultry and bee culture, dairy and meat products, and chemistry. It maintains a staff of ten re-

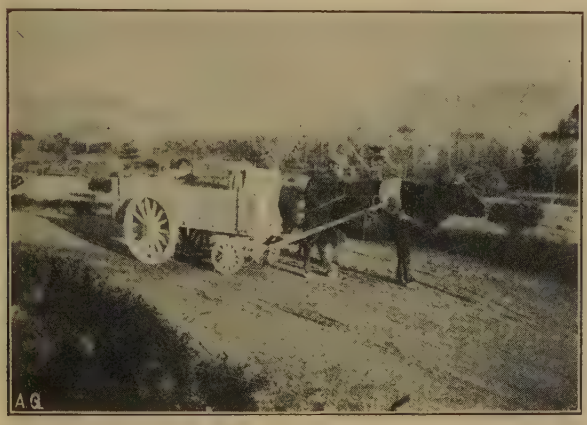

Fig. 8.—The common cart in Central and Southern Japan. The driver does not ride in the cart, so the ox can pull a heavier load. Photograph taken at Fukuoka, Kyushu Island.

searchers and sixteen assistants. Its animal equipment consists of the following:

Cattle (Holsteins, Ayrshires, Angus, Japanese, and grades)	85	head
Horses, for work	14	head
Goats, (Saanen)	12	head
Sheep, (Corriedale and Shropshire)	4	head
Pigs, (Yorkshires, Berkshires, Durocs, Poland Chinas, and Cross-breeds)	255	head
Rabbits, (Belgian and others)	60	head
Poultry, (White Leghorns, Barred Plymouth Rocks, Rhode Island Reds, Nagoyas, and Crossbreeds)	1749	
Honey bees, (Italians and others)	32	colonies

It is proposed to add in the near future breeding horses to the equipment of the station.

Among the research problems undertaken are: relation of conformation to age in dairy cattle, merits of the Holstein-Japanese and Aberdeen Angus-Japanese crosses, value of different swine and poultry crossbreeds,

physiology of reproduction in fowls, effect of illumination and ultra violet rays on laying hens and growing chicks, variation and heredity in the weight of eggs, problems in baby chick and bee transportation, breeding bees for high yield, prevention and cure of swine plague, contagious swine enteritis, animal parasites in general, preparation of starters, manufacture of fermented milk products with a view of skim milk utilization, preparation of ham, bacon, and sausages, pork canning, digestibility and feeding studies, urine putrefaction in barn yard manure, etc.

The station is well equipped for the different lines of work it has undertaken. Considering the few years it has been in operation it has to its credit a very considerable amount of work accomplished, the accounts of which have appeared in the Bulletin of the Imperial Zoötechnical Experiment Station, published by the station, and in the *Japanese Journal of Zootechnical Science*. The staff of the station is composed of well-trained and progressive young men.

OTHER LIVE STOCK PROMOTION AGENCIES

In addition to the agencies for promotion of live stock industries in Japan, mentioned in the foregoing pages, the government stimulates by means of subsidies the formation of breeders' associations, co-operative creameries, condenseries, cow testing associations, and marketing organizations, and the holding of live stock fairs, contributing not only prizes but also judges and lecturers. Each prefecture maintains a live stock farm for the propagation of desirable stock, maintaining males of the different farm animals for public breeding and breeding stock for sale to the public. These farms are partly subsidized by the Imperial government.

GENERAL REMARKS

A study of the development of the live stock industry of Japan cannot help but bring one to the realization that it is all a planned development dictated by the statesmen of the country. Because of this it has been rapid, thorough, and straight to the point, suffering little from wasted efforts due to an indefinite or a wavering goal. It is doubtful whether any other form of government than a benevolent autocracy could have carried on such a consistent program of development. Japan realized that its lack of home supply of various animals and animal products was a menace to its integrity, and forthwith started to remedy the situation. There was little argument about it, no room for quibbling, the country needed it, and the country had to have it. Japan opened her coffers and poured out gold that she might attain the needed development in a decade or a score of years that other countries have with painful slowness acquired in one or two centuries.

There are obvious lessons for us in the Philippines in the experience of Japan: (1) That animal and animal products are vital necessities to an enlightened country; (2) That the development of a live stock industry is a very slow process which can be hurried only within limits and at a considerable expense.

Do we desire a well developed live stock industry for the Philippines twenty-five years, fifty years, or a century hence? The answer lies with our public men, but at the rate in which money is doled out at present in homeopathic doses for this important project, it may take a century or two before we can have an appreciable development.

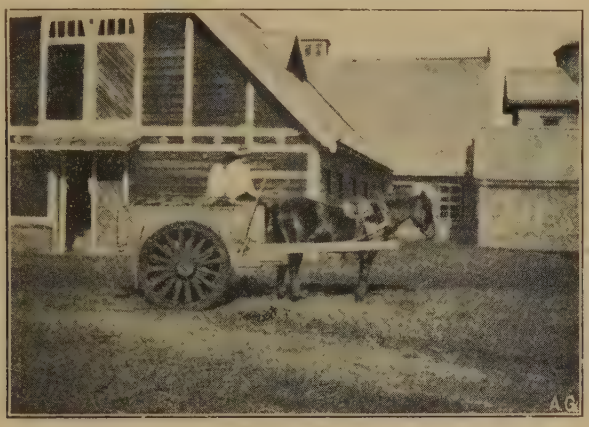

Fig. 9.—Common type of cart in Hokkaido. There is plenty of horse power in the northern Island.

ACKNOWLEDGMENTS

This article concludes the series on "Education and Agricultural Promotion in Japan".

The writer desires to express his sincere appreciation to the following gentlemen, colleagues in the profession, who were most helpful in furnishing him the data used as a basis for these articles and who facilitated his visits to the different educational and research institutions, stock farms, and live stock enterprises in their respective localities: Dr. H. Ando, Director of the Imperial Agricultural Experiment Station, Director K. Kimura and the members of his staff at the Imperial Zoötechnical Experiment Station, Prof. A. Miyawaki of Hokkaido Imperial University, The Hokkaido Dairymen's Association, Director K. Taguchi of the National Sheep Farm at Tsukisappu, Director T. Ban and Mr. K. Mitui of the O-u National Stud Farm, Mr. R. Kishi, assistant chief of the Animal Husbandry Section of the Bureau of Animal Industry, and Mr. S. Narita, Dr. N. Nitta of Tokyo Imperial University, Prof. H. Yuasa of Kyoto Imperial University, and Dean S. Kato and Profs. Y. Tanaka, S. Morinaga, and K. Sasaki of the Kyushu Imperial University. To a number of others whose names the writer cannot recall at present, his thanks are also due.

SOME ECONOMIC PHASES OF RICE PRODUCTION IN SOME TOWNS OF LAGUNA[1]

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INTRODUCTION

The problem

The Philippine rice farmer has some problems quite the opposite of those other crop producers meet. He produces rice, the main bulk of the food of the Filipino people, and yet oftentimes is himself short of rice in certain months of the year. This incredible situation is the result of certain socio-economic causes some of which are here given. The rice farmer has no source of permanent income except his small rice farm. Hence, only by the sale of his rice product can he get money to buy necessary supplies for his family. Usually, circumstances are such that the crop is sold long before it is harvested, or immediately after harvest. As he sells at a time when rice is abundant the price is low. Also, being in dire need of money he is at the mercy of the rice buyer or middleman. Having sold the greater part of his crop the farmer later in the year has to buy rice for food when the cereal is scarce and the price higher than when he sold. Having no money he is forced to borrow rice from a capitalist, a middleman or, oftentimes, from his landlord, at a very high rate of interest, or to buy at an exorbitant price. To quote Aurelio (1915): "in many cases they are forced to pawn their crop by promising to pay with rice at a price far less than the previous. For example, a farmer borrows ₱10 by pledging his crop at ₱1 a cavan. After the harvest he pays his creditor 10 cavans though rice at the time is ₱3 or more a cavan".

The rice farmer is always at the mercy of an unscrupulous middleman or a crafty landlord. He has no chance for improving his economic condition, and in most cases he is buried in debt and bound to be a tenant for life.

Such economic questions need serious consideration. They cannot be answered by experimentation nor by scientific culture methods. They may be solved only by gradual social reforms, but practically no effort is being exerted in this direction or to raise the standard of living of our peasant farmers who form the bulk of the Philippine population.

[1] Experiment Station contribution No. 460. Received for publication June 27, 1927.

Review of past literature

Much has been written about the social and economic conditions of the Philippine rice farmer. Each writer has noted discouraging financial conditions, yet there seems to be no hope for the farmer to better his status unless help comes from the outside.

"Philippine tenancy," according to Hester (1923), "is heavily weighted with debt. Tenants accept, indeed require advances which are granted by the landlord at rates of interest which appear exceptionally high unless the low security is taken into consideration." He further states that "after the tenant has paid interest on former debts out of his share of the harvest he seldom has enough rice left to his share to last him until the following harvest. In addition, the tenant not infrequently sells a part of his share and throws himself and his family upon the landlord's mercy. . . . . The landlord has no alternative but to offset the almost total absence of security with a usurious rate of interest."

Several investigations on tenancy in certain parts of the Philippines have been carried on and have shown that debt is very common among tenants.

Teruel (1923) reports in his investigation of tenancy in Bay, Laguna, "₱900.00 of consumptive loans from landlords, ₱2097.50 of productive loans from landlords; a total of ₱2997.50, or an average of ₱18.734 for each of the 160 tenants and ₱8.907 per hectare of the survey.

"Most of the loans were in the form of palay and were to be paid in palay at about 25 centavos less per cavan than the price at time of loan."

"Of the 81 tenants in Sta. Rosa, Laguna," surveyed by Laserna (1922), "33 had taken no loans whatsoever. There were 41 consumptive loans which ranged in amount from ₱8.00, the smallest, to ₱500.00, the largest, the length of time varying from 2 months to 19 months. The total consumptive loans amounted to ₱7939.88, an average of 98.02 for each tenant."

Of the 151 tenants studied in Naic, Cavite, by Rodis (1922), "78 had advances from their landlords of palay or money, both to be repaid in palay at the end of from one to six months at rates varying from 35 to 290 per cent per annum. Reducing the palay loans to their market-based money value the total amount of the loans of the tenants was ₱405.60.

"For the survey there were 128 tenants who had contracted third party loans to the principal amount of ₱1062.40. The average encumbrance for each of the 151 tenants was therefore ₱8.30, and for each of the 151 tenants surveyed, ₱7.04, and for each of the 343,389 hectares of the survey, ₱3.09."

Miller (1920) quotes from an unpublished report of Percy A. Hill on, "Circle for the Study of Social and Economic Conditions in the Philippines." "The crop once planted, the ration of palay is usually discontinued; but the family has to exist, and so a new schedule is put into force, that of *terkiaan* 50% increase or *takipan* 100% increase, so that if a tenant receives

five cavans between planting and harvest he must pay back seven and a half cavans if *terkiaan*, or 10 cavans if *takipan*. . . . . Generally all he has left is an increased debt and the four per cent received by the women for winnowing; however he manages to exist until cropping commences again, when he resumes his ration and debt."

Objects of the present work

The survey here discussed was only preliminary and was on a small scale. The objects were few, but of quite different nature. The points taken are those that were not touched upon or only slightly by previous investigators on similar subjects. The following were the objects of the investigation: (*a*) To determine the actual earnings of a labor-trader, that is a farm laborer who exchanges work for product rather than for cash wages. The labor-traders herein considered are only the rice threshers and the harvester. (*b*) To ascertain the real causes for farmers selling their rice immediately after harvest. (*c*) To determine the probable loss incurred by the farmer when he disposes of his palay immediately after harvest instead of storing it for sale, later.

Time and scope of the survey

The survey was made during March, 1927, in the towns of Los Baños, Cabuyao, Sta. Rosa, and Biñang, all in the province of Laguna.

METHOD OF THE SURVEY

The survey was performed under the direction of Professor Charles F. Baker, Dean of the College of Agriculture, and Professor Inocencio Elayda, Director of Extension Service of the same college. The writer was given two sets of simple questionnaires. A house to house survey was made in the barrios of the towns included in the survey. In the case of the threshers, they were interviewed right in the field while the rice was being threshed. Timing and observation were made during the progress of the work. Besides the given questionnaires other questions bearing on the economic condition of the farmer were asked. Since the questions were short and simple it did not take long to interview one person.

RESULTS OF THE SURVEY

Number of people interviewed

In the whole survey a total of 227 people were interviewed. They were distributed by towns as follows.

Los Baños	62
Cabuyao	60
Sta. Rosa	35
Biñang	70
Total	227

Of these, 125 were threshers, 102 both harvesters and threshers, and 80, peasant farmers who were also threshers and harvesters.

Methods of sharing the harvest

Two ways of giving shares to the harvesters were found. The first, which is practiced in Los Baños, has this agreement: the harvesters harvest the rice by hand, using a kind of knife made especially for the purpose. Each one threshes his own harvest. After he has threshed and cleaned his own harvest the harvester hands it to the owner and the division is made. The harvester gets one-fifth of the palay he harvests. The second way which is practiced in Cabuyao, Biñang, and Sta. Rosa has this arrangement: the harvesters harvest the rice in the same way as in Los Baños. After the harvest the unthreshed palay is divided at once between the owner and the harvester, the harvester getting one-tenth of the rice as his share. The owner's share is piled together and put in a stack; later, it is threshed by another group of men. Threshing takes place usually from the middle of February to the end of March, and is done by beating the grain with a bamboo flail especially made for the purpose. The threshers are usually organized in teams, of from five to twenty people (men and women). A team receives five cavans for every 100 cavans threshed. This means a share of 4.7 per cent of the total amount they thresh. The share of five cavans is divided equally among the members of the team.

Earnings of the threshers

The data obtained on threshing may be considered accurate because they were obtained in the field during the actual operation. Ten groups of threshers were observed during the course of the investigation. The accompanying table shows data on actual earnings of the thresher.

TABLE 1

Showing earnings of a thresher

TEAM NO.	NUMBER OF MEN ENGAGED	NUMBER OF HOURS WORK	NUMBER OF CAVANS THRESHED	AVERAGE SHARE OF EACH LABORER IN CAVANS PER HOUR
1	23	8	125	.0318
2	17	8	120	.0412
3	15	9	120	.0415
4	13	7	90	.0464
5	4	14	30	.0251
6	11	11	100	.0388
7	7	10	50	.0335
8	15	9	80	.0268
9	10	7	65	.0436
10	10	7	55	.0369
			Average...	.03656

Column five was obtained by multiplying the number of cavans threshed by all the men by 4.7 per cent which is the usual rate given as share, dividing the result by the number of men, and then by the number of hours spent in threshing.

The earnings of a man an hour in terms of money depend upon the price of palay at the time. If the price of palay is ₱3.00, ₱3.50, ₱4.00, and ₱5.00, then the earnings of a man an hour by threshing will be ₱0.1095, ₱0.12775, ₱0.146 and ₱0.1825.

The harvester

The harvesters considered are those from Cabuyao, Biñang, and Sta. Rosa. These harvesters get one-tenth of the unthreshed rice as their share for harvesting. From records obtained from about one hundred of these harvesters the writer computed the earnings of each harvester an hour to be an average of 1.172 gantas or. 047 cavans. Reduced to money values the harvester can earn at least ₱.141 per hour.

Earnings of the Los Baños labor-trader

As the Los Baños share system differs from that of the other three towns investigated, the earnings of the Los Baños labor-trader would not be the same as in these towns. From reports of 62 persons in Los Baños the writer found that an average of 2.1 gantas or .084 cavans was the share of each laborer per hour of work. The work is a combination of harvesting, threshing, and cleaning, all done on the same day. Reducing the earnings to money values it is evident that if the price of palay is ₱3.00, which is the lowest price, the laborer will earn ₱0.252 per hour. So the Los Baños labor trader can earn at least ₱0.25 per hour.

Comparison of shares between the two systems

In the one-fifth share contract, the share of the laborer is .084 per hour. Adding .03656 cavans and .047 cavans the shares of two sets of laborers in the two contracts we have .08350 cavans, the sum of the shares of the two laborers for one hour work in the Cabuyao, Sta. Rosa, Biñang system. Therefore, there is a difference of .00044 cavans in favor of the Los Baños system. The other share is a product of two hours labor by one

laborer. Apparently, the Los Baños system is more advantageous to the laborer, but not to the landowner.

TABLE 2

Showing the relation of the price of palay to the farmer's farm operation

MONTH	FARMER'S WORK	CONDITION OF RICE SUPPLY	PRICES OF RICE AND PALAY	FARMER'S CONDITION
December January	Harvesting lowland rice	Rice abundant in lowlands. Farmer's selling season, supply plentiful, prices comparatively low.	*Clean rice* From ₱.25 to ₱.35 a ganta or from ₱6.25 to ₱8.75 a cavan. *Palay* From ₱3 to ₱4 a cavan. Av. report ₱3.63 a cavan.	Farmer sells rice. Season of entertainments and fiestas, etc.
February	No farm work			
March	Threshing rice			
April	No farm work			
May June	Preparation of land	Rice scarce. Prices high, most farmers supply low.	*Clean rice* From ₱.40 to ₱.50 a ganta. *Palay* From ₱4 to ₱6 a cavan. Av. ₱4.82	Most farmers short of rice. Season of buying, pawning, or borrowing.
July August	Planting season in lowlands			
September October November	Caring for growing rice	Fair supply because of harvest from uplands. Prices medium.	*Clean rice* From ₱.35 to ₱.40 a ganta. *Palay* From ₱3 to ₱3.50 a cavan.	Farmer subsists on upland rice.

As may be seen from table 2 the farmer sells palay at an average price of ₱3.63 a cavan and buys at an average price of ₱4.82. Thus by selling his rice immediately after harvest during the season of plenty instead of holding it until the time of scarcity he loses 35.5 per cent. For example, a farmer who produces 200 cavans of rice will get only ₱726 if he sells immediately after harvest at ₱3.63, whereas if he waits till the time of scarcity he can sell at ₱4.82 and get ₱964 for his 200 cavans. Even granting that the ₱726 earns interest, say 10 per cent, for five months there would still be the difference of ₱207.75 in favor of the returns in time of scarcity. This condition will not change even if all the farmers hold their rice. The market for rice is very wide and during the months of May to August, the time in which rice is scarce in most parts of the Philippines, the price of rice is always high. In this event what actually will happen is that the rice will change hands, and, possibly, middlemen will be eliminated. Instead

of the middlemen holding the rice, the farmers themselves will. The figures obtained appear rather conservative because the rice advanced by middlemen at usurious rate of interest is not included. The item "advanced rice" was not included in this investigation as it was well covered by previous investigators.

Availability of secondary occupation in the region surveyed

While conducting the survey the writer was interested to find that the after-harvest selling of rice did not prevail among Los Baños farmers. No matter how hard up the Los Baños farmer may be, he does not sell his rice right after harvest unless he has an over-supply. The Los Baños farmer or labor-trader can hold his rice because there is always available labor in the vicinity. The College of Agriculture, the quarry under the Bureau of Public Works, and occasionally Camp Eldridge, the United States Army Post, all located in the municipality, are the sources of employment. Another reason is that rice growing is only a minor industry in Los Baños, only enough is produced for home consumption. In the other towns surveyed, farming is the primary occupation of the farmers. Except such minor secondary occupations as driving cart or carromata or some road work, work in these towns is very uncertain, hence, there being no other way to get cash, the rice is sold as soon as it is threshed.

DISCUSSION OF RESULTS

Two systems of giving shares to the labor-trader was found and the actual share of each per hour was determined. Under the Los Baños system a laborer gets .084 cavan per hour, while in the Cabuyao, Sta. Rosa, Biñang system he gets .047 cavan per hour for harvesting and .03656 cavan per hour for threshing. Only men and women are considered in this investigation. Children are found to be of little use in these operations. Men and women are rated equally because it is said that on the average their ability in this kind of work is practically the same.

The data presented covering the share of a labor-trader are based on the hour because it would be very misleading if based on the day. The number of working hours of laborers vary from two to ten hours a day, consequently, earnings a day are variable.

From the results it may be seen that the hourly earnings of a labor-trader are fairly high. Ten centavos an hour on the farm is comparatively good wages in the Philippines, the drawback is that laborers cannot work for many consecutive hours. For example, many harvesters work in one field, with the result that after three or four hours the work is finished and the laborer's daily wage as a thresher or a harvester is low. As a matter of fact, the labor-trader is very lucky if he works on the average of four hours a day during harvest time, especially in places like Los Baños where the rice fields are not very large. In the other three towns surveyed where

most of the farm is planted to rice, the labor-trader has longer work days than in Los Baños. This explains why the laborers are content though their wage per hour is lower than that of the Los Baños labor-trader.

As there is much jollity at harvest and threshing time, the labor-trader considers the work a species of fiesta as well as a mode of earning wages. It is always inspiring for the young men to have fair damsels working with them. One might say that harvesting and threshing time is a sort of social season for the rice farmers. Sometimes, to make the harvesting a lively affair, young women are especially invited.

Table 2 shows the relation of the rice supply to the price of rice. It was found that during and after harvest the price of palay is comparatively low. The average price of palay during harvest is ₱3.63 a cavan, while in time of scarcity it rises as high as ₱6.00 a cavan, the average being about ₱4.82. The farmer loses about 35.5 per cent of the money he would have received had he been able to wait for the time of scarcity.

It was found that in Cabuyao, Sta. Rosa, and Biñang, most farmers are compelled to sell their rice immediately after threshing. They are always in need of money for household needs, as they have no source of permanent income. If a farmer has a permanent secondary occupation he may hold his rice. This is the case with the Los Baños farmers, who are the best-off among the towns surveyed. This comparatively well-to-do condition of the Los Baños farmer is explained by the fact that when they are through with their farm labor, they can earn at least one peso a day as a common laborer. Hence, Los Baños farmers do not sell their rice unless they have a surplus, because they can always earn ready money by other work than farming. In the other three towns there are a few home industries and secondary occupations, but returns are very uncertain.

There are other major causes for farmers and farm laborers disposing of their rice immediately after harvest. There are many farmers whose production is enough for their family subsistence, but they are in debt. The Filipino farmer has one fundamental defect—lack of foresight. He does not plan for incidental expenses. Once such expenses occur, since he has no savings, he has to borrow money or pawn his crop. On this, Hester (1923) says: "Consumptive loans are made generally in cash granted by the landlord to the tenant for the purpose of supplying the outlay for a tenant marriage, baptism or funeral, ceremonies which in the Philippines involve the spreading of feast and expenditures of time and money out of proportion to all other points in the standard of living. Not infrequently a funeral will cost the tenant's family in money and food a sum equal to one-half of their annual income." Once this debt is incurred it is paid in palay at a fixed price, with the result that they never get the full money value for their crops.

Since the most apparent cause responsible for the present financial condition of the rice farmer is that he is jobless so much of the time (cer-

tainly in Los Baños where this condition does not obtain, the farmer is better off), the obvious remedy is to make conditions such that the farmers are busy throughout the year. One possible way to do this is induce the farmer to practice diversified farming. At present he is following the one crop system "abandoned in China, Japan, and Europe centuries ago." In the towns surveyed, diversification cannot be practised unless irrigation systems are constructed, because after the rice is harvested no crop will grow because the soil is too dry.

If irrigation systems cannot be constructed the other possibility is to develop many home industries so as to provide work for laborers during the dry season. The blame for the deplorable condition of indebtedness of the farmers cannot be wholly laid on them, because frequently circumstances force them to be idle. Jobs are not available and they cannot till the soil in the dry season, but they and their families have to eat, so if they have not produced enough for subsistence they have to go in debt.

SUMMARY

Since this survey was very limited in scope and preliminary in plan no broad and definite conclusions can be drawn. Only a summary is here given.

1. Two types of sharing the harvest were found in the area surveyed. The Los Baños type in which the labor-trader is the harvester and the thresher at the same time and gets one-fifth of the harvest as share, and the Cabuyao, Sta. Rosa, and Biñang type in which harvesting and threshing are done by separate groups of people, the harvester getting one-tenth as share and the thresher, 4.7 per cent.

2. The labor-trader in Los Baños earns .084 cavan per hour as share while the labor-trader in Cabuyao, Sta. Rosa, and Biñang earns .047 cavan by harvesting and .03656 by threshing. Reduced to money values, the Los Baños labor-trader earns about 25 centavos an hour and the other labor-traders about 10 centavos an hour.

3. The farmers sell their rice during harvest or threshing season at an average of ₱3.63 per cavan. They cannot afford to wait for better prices because there are always urgent necessities to provide or debts to pay. They have no permanent income except their rice product, so that as soon as the rice is harvested, it must be sold.

4. The farmer that gets short of rice pays an average of ₱4.82 per cavan for palay or ₱.45 a ganta for cleaned rice. The shortage usually occurs during the months of June, July, and August, the season when the farmers are busy preparing their land for planting.

5. The farmer loses about 35.5 per cent by selling his rice right after harvest and not waiting for the later higher prices in time of scarcity.

6. The farmers of Los Baños do not sell rice unless there is an oversupply because they are not in such need of money because of opportunity to earn as laborers in other lines of work.

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NON-GAS ELECTRODES FOR pH DETERMINATIONS[1]

AMADO J. DE LA CRUZ

INTRODUCTION

There are two general methods employed in the industrial determination of the hydrogen-ion concentration. The colorimetric method depends upon the changes in color that certain substances undergo when in presence of different concentrations of hydrogen. The electrometric method depends upon the fact that some metals, when used alone or in conjunction with other substances, set up definite and reproducible electrical potentials when placed in contact with definite hydrogen-ion concentration.

Each method has its advantages and disadvantages. On the one hand, in any determination where colors are to be compared with the unaided eye, errors due to the personal equation are great. Furthermore, these colors are affected by the presence of proteins or certain salts, and are not easily reproducible either on paper or in solution, owing to the effect of light and moisture. The great point in favor of the colorimetric method, however, is the ease with which a determination may be made and the minimum training necessary on the part of the observer.

With the electrical method, one great drawback is the amount of necessary technique that an observer should possess, before good results may be obtained. This is somewhat offset by the fact that personal errors are much fewer than with the color method. Another great disadvantage of the electrical method is that the electrodes are susceptible to certain specific "poisons" which completely nullify the value of the potential measurements. In the case of gas electrodes like the hydrogen electrode, where a metal is made a very good absorbent of the gas, the susceptibility to poisons becomes much greater.

In order to obviate this difficulty and the difficulty of preparing pure gases for gas electrodes, non-gas electrodes have been introduced.

Review of the literature

The first researches along the line of non-gas electrodes were made on the quinhydrone electrode by Biilmann (1921) and by Biilmann and Lund (1921). Later, Biilmann (1924) and Baver (1926) made use of this electrode

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in determining the pH of soils, while Harris (1923) studied its use in the analyses of mixtures of amino acids, and La Mer and Parsons (1923) studied its application to electrometric acid-base titrations in the presence of air. Farnell (1925) indicated its use in sugar work, giving a sketch of his apparatus, but he did not give any data on the difference of readings between the quinhydrone electrode and the hydrogen electrode at different pH values. He pointed out that while its use is much less cumbersome than the hydrogen electrode, it has the disadvantage of giving unreliable results above pH 8, (a finding also obtained by La Mer and Parsons) and it is entirely useless when used in presence of strong reducing agents, as sulfites. Later, Dawson (1926) devised a liquid-flowing junction in connection with the quinhydrone electrode for determining the pH of sugars, but he also found that this electrode could not be used reliably at a pH higher than 8.5.

Bayliss (1923), using tungsten electrodes, succeeded fairly well in measuring the hydrogen-ion concentration for potable water, and Balch and Paine (1925) have found the use of this electrode for sugar work rather efficient. Parker (1925), in studying different electrode combinations, succeeded in obtaining a few promising ones, but he did not test their uses in industrial solutions.

At the present time, no electrode combination has yet been found which possesses the advantages of being useful for a wide range of pH, of non-susceptibility to poisons, and of giving the true potential reading in a short time.

In order to understand fully the results, a discussion of the non-gas electrode is necessary.

Theory of non-gas electrodes

If the ordinary assumption is made that an oxidation-reduction reaction is a process of an exchange of electrons, it may also be further assumed, as was pointed out by Langmuir (1916), that the free electrons which have just detached themselves from either the oxidized or the reduced ions, set up a "pressure" of free electrons. At equilibrium, these electrons would set up a steady characteristic electron pressure or concentration.

In general, an oxidation-reduction reaction may be represented by the equation:

$$Oxi + ne \rightleftarrows Red,$$

Where Oxi = oxidant
Red = reductant
e = electron
n = number of electrons necessary per molecule of the oxidant.

Applying the law of Mass Action

$$\frac{(Oxi)\ (e)^n}{(Red)} = K, \text{ so that}$$

$$(e) = \sqrt[n]{K\,\frac{(Red)}{(Oxi)}} \qquad (1)$$

If the presence of free electrons in metals is assumed, as is ordinarily done, and activity a_m, ascribed to these electrons, and activity a_s to the electrons in the solution phase, then the change $\triangle F$ in free energy accompanying the isothermal transfer of one Faraday of electrons from one phase to the other is

$$\triangle F = RT \ ln \frac{a_m}{a_s} \tag{2a}$$

Here R and T have their usual significance.

If the potential difference between metal and solution is E, and F is the Faraday, then $F \times E = \triangle F$, and

$$E = \frac{RT}{F} ln \ a_m - \frac{RT}{F} ln \ a_s \tag{2b}$$

In dilute solutions, where activity and concentration are very nearly equal to each other, equation (2b) may be written as

$$E = \frac{RT}{F} ln \ (e)_m - \frac{RT}{F} ln \ (e)_s \tag{3}$$

Substituting the value of (e) in equation (1) and $(e)_s$ in equation (3),

$$E = \frac{RT}{F} ln \ (e)_m - \frac{RT}{nF} ln \ K \frac{(Red)}{(Oxi)} \tag{4a}$$

This is the single electrode potential due to an oxidation-reduction reaction.

Considering the hydrogen electrode, since

$$(2H^+ + 2.e \rightleftarrows H_2)$$

hence, $$\frac{(H^+)^2 \quad (e)^2}{(H_2)} = K'_H$$

Instead of (H_2), $K'P_{H_2}$ may be written where P_{H_2} is the partial pressure of gaseous hydrogen.

$$\text{Hence, } \frac{(H^+)^2 \quad (e)^2}{P_{H_2}} = K'_H.K', \text{ or}$$

$$(e) = \sqrt{K \frac{P_{H_2}}{H(H^+)^2}} \text{ where } K_H = K'_H.K' \tag{5}$$

Substituting (e) in equation (5) for $(e)_s$ in equation (3),

$$E = \frac{RT}{F} ln \ (e)_m - \frac{RT}{F} ln \sqrt{K_H} \frac{\sqrt{P_{H_2}}}{(H^+)}, \text{ or}$$

$$E = \frac{RT}{F} ln \ (e)_m - \frac{RT}{F} ln \sqrt{K_H} - \frac{RT}{F} ln \frac{\sqrt{P_{H_2}}}{(H^+)} \tag{6a}$$

This is the electrode potential at the hydrogen electrode.

For a metal electrode in contact with a solution containing metallic ions of the electrode, from equation (4a) follows

$$E = \frac{RT}{F} ln\ (e)_m - \frac{RT}{nF} ln\ K \frac{(M)_s}{(M^{n+})}$$

where $(M)_s$ = concentration of the metal in solution in equilibrium with the electrode, and (M^{n+}) = concentration of the metallic ions in solution.

Since the concentration of the metal in solution is supposedly in equilibrium with the undissociated metal, that is, $(M)_s = K''_1(M)_m$, the above equation may be written thus:

$$E = \frac{RT}{F} ln\ (e)_m - \frac{RT}{nF} ln\ K\ K''_1(M)_m - \frac{RT}{nF} ln \frac{1}{(M^{n+})} \quad (7a)$$

Gathering the constants in each of the equations (4a), (6a), and (7a), there is:

For the potential at the oxidation-reduction electrode:

$$E = E_1 - \frac{R\ T}{n\ F} ln \frac{(Red)}{(Oxi)} \quad (4b)$$

For the potential at the hydrogen electrode:

$$E = E_2 - \frac{RT}{F} ln \frac{\sqrt{P_{H_2}}}{(H^+)} \quad (6b)$$

For the potential of the metal electrode in contact with its metallic ions:

$$E = E_3 + \frac{R\ T}{n\ F} ln\ (M^{n+}) \quad (7b)$$

From these equations, it is evident that a given electrode may be regarded either as an oxidation-reduction electrode, hydrogen electrode, or a metal electrode in contact with its metallic ions.

However, if the electrode is to be used either as a hydrogen (or an oxygen) electrode, in order that the true value for E may be determined, there must be, around the electrode, a definite or finite pressure of either the hydrogen or oxygen gas.

To avoid the necessity of creating definite pressures of either H_2 or O_2 for their respective electrodes, the more plausible method would be to utilize the oxidation-reduction electrode where the E does not require definite H_2 or O_2 pressures.

To consider a general example of the oxidation-reaction potential:

Take an oxide and assume that the solution contains a reducing electrolyte of the type HB where H denotes the replaceable hydrogen and B denotes the anion ($HB \rightleftarrows H^+ + B^-$).

The reduction of the oxide may be represented thus:

$$\underset{\text{oxide}}{MO_n} + ne \overset{n\,H_2O}{\rightleftarrows} MO_{2n}^{(-)n} + 2nH^+,$$

(Here M is the metal)

or the dissociation of the hydroxide may be represented according to the following:

$$M(OH)_n \rightleftarrows M(OH)_{n-1}O^- + H^+$$
$$\downarrow\uparrow$$
$$M(OH)_{n-2}O_2^{=} + H^+$$
$$\downarrow\uparrow$$
$$M(OH)_{n-3}O_3^{\equiv} + H^+, \text{ etc.}$$

The mass action equations of the above reactions may be written as:

$$k_1 = \frac{[M(OH)_{n-1}O^-]\ [H^+]}{[M\ (OH)_n]} \qquad (a)$$

$$k_2 = \frac{[M(OH)_{n-2}\ O_2^{=}]\ [H^+]}{[M\ (OH)_{n-1}O^-]} \qquad (b)$$

$$k_3 = \frac{[M(OH)_{n-3}\ O_3^{\equiv}]\ [H^+]}{[M(OH)_{n-2}O_2^{=}]} \qquad (c)$$

and

$$[M(OH)_n]_{total} = [M(OH)_n] + [M(OH)_{n-1}O^-] + [M(OH)_{n-2}O_2^{=}] + [M(OH)_{n-3}O_3^{\equiv}] \qquad (z)$$

If the reduction takes place in only one stage and if the degree of dissociation is very small, then from equations (*a*) and (*z*), the value of $\frac{[Red]}{[Oxi]}$ may be written thus:

$$\frac{[Red]}{[Oxi]} = \frac{[M(OH)_{n-1}O^-]}{[MO_n]} = \frac{k_1\ [M(OH)_n]_{total}}{[H^+]\ [MO_n]}$$

so that from equation (4b), the following equation may be written:

$$E = E_1 - \frac{R\,T}{F}\,ln\,\frac{k_1\,[M(OH)_n]_{\,total}}{[H^+]\quad[MO_n]}$$

$$= E_1 - \frac{R\,T}{F}\,ln\,k_1 - \frac{R\,T}{F}\,ln\,\frac{[M(OH)_n]_{\,total}}{[MO_n]} + \frac{R\,T}{F}\,ln\,[H^+]$$

or

$$E = E'_1 - \frac{R\,T}{F}\,ln\,\frac{[M(OH)_{n\ total}}{[MO_n]} + \frac{R\,T}{F}\,ln\,[H^+] \qquad (8a)$$

Under rather alkaline conditions, when the concentrations of both the oxide and the hydroxide may be considered constant, equation (8a) may be written,

$$E = E''_1 + \frac{R\,T}{F}\,ln\,[H^+] \qquad (8b)$$

If the dissociation of the hydroxide takes place in two stages, then from equations (a), (b), and (z),

$$[M(OH)_{n-2}\ O_2^{=}] = \frac{k_1\ k_2\ [M(OH)_n]\ total}{[H^+]^2 + k_1\ [H^+] + k_1\ k_2}, \text{ so that}$$

equation (4b) may be written as

$$E = E_1 - \frac{R\,T}{2\,F}\,ln\,\frac{k_1\ k_2\ [M(OH)n]\ total}{[MO_n]\ [(H^+)^2 + k_1\ (H^+) + k_1\ k_2]}$$

$$= E_1 - \frac{R\,T}{2\,F}\,ln\,k_1\ k_2 - \frac{R\,T}{2\,F}\,ln\,\frac{[M(OH)_n]\ total}{[\ MO_n]} +$$

$$\frac{R\,T}{2\,F}\,ln\,[(H^+)^2 + k_1\ (H^+) + k_1\ k_2]$$

Again, under certain alkaline conditions, and collecting terms,

$$E = E_1''' + \frac{R\,T}{2F}\,ln\,[(H^+)^2 + k_1\ (H^+) + k_1\ k_2] \qquad (9a)$$

Furthermore, if the values of k_1 and k_2 are small in comparison with the value of (H^+), as in the case of the quinhydrone electrode, ($k_1 = 1.75 \times 10^{-10}$ and $k_2 = 4 \times 10^{-12}$), equation (9a) may be further reduced thus:

$$E = E_1''' + \frac{R\,T}{F}\,ln\,[H^+] \qquad (9b)$$

which is similar to equation (8b).

If, however, the values of k_1 and k_2 are very large in comparison with (H^+), then it is evident that

$$E = E_1''' + \frac{RT}{2F} ln\ (k_1\ k_2), \text{ or}$$

$$E = constant. \tag{9c}$$

that is, the value of the observed e.m.f. of the electrode is constant.

Between these two extremes, of course, lie values of (H^+), k_1 and k_2 which are more or less comparable.

Equation (6b) may be written

$$E_H = E_2 - \frac{R\ T}{F} ln \sqrt{P_{H_2}} + \frac{R\ T}{F} ln\ (H^+) \tag{6c}$$

If, therefore, a hydrogen electrode be set up against an oxidation-reduction electrode, from (8b) or (9b) and (6c),

$$E_{o-r} - E_H = E_1'' - E_2 + \frac{R\ T}{F} ln \sqrt{P_{H_2}} \tag{10}$$

So that it may be said that the resultant potential is independent of the hydrogen ion concentration of the solution.

Object of the present work

The purposes of the present investigation were to find suitable non-gas electrodes, which would be ideal for the determination of the hydrogen-ion concentration of some solutions. It was the purpose, especially, to find electrodes that may be used in determining the hydrogen-ion concentration of sugar cane juice, and to offer suggestions for further investigation on the subject in its application to factory scale processes.

Time and place of the present work

The experiments were conducted in the Department of Agricultural Chemistry, College of Agriculture, from April 20, 1926, to February 12, 1927, a period of about ten months.

MATERIALS AND METHODS

Buffer solutions and other chemicals

Throughout the investigation the water that was used for the buffer solutions was distilled three times in glass condensers, and kept in non-sol bottles. In the preparation of the buffer solutions the chemicals used were fractionally cyrstallized four times from the C. P. chemicals and thoroughly dried in an electric oven at 110°C. For the method used in preparing these buffer solutions, that given by Clark (1922, p. 107) was followed.

In the preparation of the calomel electrode the KCl used was fractionally crystallized four times from C. P. KCl. The mercury used was purified according to Clark (1922).

The quinhydrone used was prepared by the Division of Soils and Fertilizers of the Bureau of Science, Manila. No attempt was made to purify this compound.

For the solutions to be investigated, sugar juices were daily obtained from the field and clarified with lime or NaOH. In some cases the juice was allowed to stand for one or more days, during which time the protein matter settled. In other cases, the clarified juice was treated with acid to lower the value of its pH.

In the preparation of the HCl and NaOH solutions, the ordinary analytical methods were followed.

The potentiometer

For the measurement of the electrode potential, the type K potentiometer of Leeds & Northrup was employed. In conjunction with this apparatus a portable galvanometer of Leeds & Northrup, a Weston standard cell Model 4, and a 2-volt storage battery were used.

Non-gas electrodes

In the search for the best electrode combinations that satisfy the requirements of an ideal electrode the following combinations of non-gas electrodes were studied:

Quinhydrone electrode
Cu No. 24, BaO_2
Cu No. 28, BaO_2
Cu No. 24, H_2O_3
Cu No. 28, Al_2O_3
Cu No. 30, Al_2O_3
Cu No. 24, PbO_2
Cu No. 28, PbO_2
Cu No. 30, PbO_2
Cu No. 24, Fe_2O_3
Cu No. 28, Fe_2O_3
Cu No. 30, Fe_2O_3
Cu No. 24, CuO (red)
Cu No. 28, CuO (red)
Cu No. 30, CuO (red)
Cu No. 24, CuO (black)
Cu No. 28, CuO (black)
Cu No. 30, CuO (black)
Al, BaO_2
Al, Al_2O_3
Al, PbO_2
Al, Fe_2O_3
Al, CuO (red)
Al, CuO (black)

The wires and the oxides used for these electrodes were obtained, as "Baker's Analyzed Chemicals," from J. T. Baker Chemical Co.

After many trials, it was found that, besides the quinhydrone electrode, the electrode which gave the most easily reproducible potential was the Al,

BaO_2 combination. To prepare this electrode, a No. 14 aluminum wire was thoroughly cleaned by rubbing it with alcohol and ether and then made into a coil about five centimeters long. An aqueous solution of C. P. $BaCl_2$ was then prepared and a few drops of this mixed with C. P. Baker's Analyzed acetone. Two aluminum coils were dipped in this solution and these coils were then electrolyzed by changing the electrode poles alternately positive and negative every five minutes for about two hours. When dried in an electric oven, the electrodes, originally metallic, became coated with a thin adherent white coating of BaO_2.

In order that reproducible electrode potentials could be obtained, it was found necessary to continuously stir the solution under investigation. For this purpose, an electric motor in conjunction with a glass stirrer was employed.

In preparing the quinhydrone electrode, the method of Baver (1926) was followed with slight modifications. The solution under investigation was placed in a 50 cc. beaker and a pinch of quinhydrone (about 0.05 gram) added to it. Then a platinum electrode about one centimeter square, sealed to a glass tube filled with mercury, was dipped in the solution. Readings of the potentiometer were made exactly one minute after the addition of the quinhydrone to the solution. To keep the surface of the platinum bright, it was cleaned with chromic acid solution after every twenty readings. To prevent diffusion from the solution to the KCl solution of the calomel electrode, a small bridge filled with agar dissolved in KCl solution of the same strength as that of the calomel electrode was used.

No control of the temperature was made; the room had a temperature of from 25° to 28°C. Nor were barometric corrections made, as the error due to these are, for the purpose of this study, small.

EXPERIMENTS AND RESULTS

Table 1 gives the e.m.f. of the system Al, BaO_2—HA—calomel, containing the buffers HA of different hydrogen-ion concentrations. Four different aluminum electrodes were used; these were first dried at 60°C. for 10 minutes before immersion in the solutions.

TABLE 1

e. m. f. of the cell Al, BaO_2—HA—normal calomel electrode containing different buffer solutions

	E_1	E_2	E_3	E_4	E *average*
pH of buffer	*volts*	*volts*	*volts*	*volts*	*volts*
10.01	1.463	1.463	1.464	1.466	1.464
9.38	1.262	1.262	1.267	1.263	1.263
9.00	1.138	1.142	1.148	1.152	1.145
8.47	0.990	0.998	0.998	0.990	0.991
8.07	0.884	0.892	0.886	0.885	0.887
7.00	0.571	0.567	0.577	0.584	0.575
6.05	0.499	0.491	0.497	0.494	0.495

The pH of the buffer solutions were determined separately by means of the hydrogen electrode.

The time necessary for obtaining a constant potential was rather long, and it was thought that if instead of drying in the oven, the electrodes were soaked in distilled water preparatory to immersion in the buffer solution, the equilibrium time would be reduced. Table 2 gives the average equilibrium time for the electrodes when dried in the oven and when soaked in water for five minutes.

TABLE 2

Comparison of equilibrium time for dried and wet electrodes

pH	AVERAGE EQUILIBRIUM TIME STARTING WITH DRIED ELECTRODES	AVERAGE EQUILIBRIUM TIME STARTING WITH WET ELECTRODES
	min.	*min.*
10.0	50	50
9.5	90	55
9.0	80	65
8.5	90	100
8.1	65	95
7.0	50	55
6.1	40	45

Table 3 gives the average values of the e.m.f. of the system Al, BaO_2—HA—H_2Pt when the HA of the buffer solutions has different pH. The hydrogen electrode is here considered positive.

TABLE 3

e. m. f. of the system Al, BaO_2—HA —H_2Pt containing different buffer solutions

pH	AVERAGE E. M. F. OF THE CELL VOLTS
10.0	+0.574
9.4	+0.423
9.0	+0.141
8.5	+0.214
8.1	−0.013
7.0	−0.161
6.0	−0.263

Table 4 gives the e.m.f. of the system, Al, BaO_2—HA—calomel, containing the solutions of partially neutralized HCl and NaOH the pH of which has been determined by the hydrogen electrode. Each value of the

pH around the range 7 to 10 is compared with the value calculated from the results of table 1. The equilibrium time for the electrode is also given.

TABLE 4

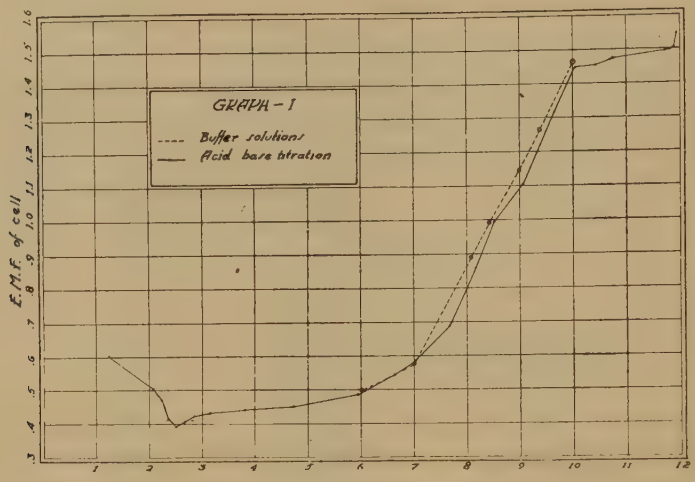
Comparison between the hydrogen and the Al, BaO_2 electrode in acid-base titrations around the range pH 7–10

SOLUTIONS USED	E.M.F. OF THE CELL, Al, BaO_2—HA —CALOMEL	pH CALCULATED FROM EQUATION (11)	pH DETERMINED BY THE HYDROGEN ELECTRODE	DIFFERENCE IN THE pH	TIME OF EQUILIBRIUM FOR THE Al—BaO_2 ELECTRODE
					min.
N/100 HCl	0.506		2.08		20
200 cc. N/100 HCl + 20 cc. N/100 NaOH	0.474		2.22		25
200 " " + 40 " "	0.417		2.35		20
200 " " + 60 " "	0.396		2.49		25
200 " " + 80 " "	0.405		2.65		25
200 " " +100 " "	0.423		2.85		30
100 " " + 60 " "	0.436		3.15		35
100 " " + 70 " "	0.443		3.80		35
100 " " + 80 " "	0.452		4.72		35
100 " " + 90 " "	0.485	6.81	5.96	0.85	30
100 " " + 95 " "	0.548	7.02	6.63	0.39	35
100 " " +100 " "	0.584	7.02	7.01	0.01	35
	0.686	7.43	7.67	0.24	30
97 " " +100 " "	0.860	8.05	8.18	0.13	55
95 " " +100 " "	0.996	8.50	8.52	0.02	55
90 " " +100 " "	1.123	8.95	9.06	0.13	45
80 " " +100 " "	1.320	9.57	9.66	0.09	55
70 " " +100 " "	1.448	9.99	10.03	0.04	60
60 " " +100 " "	1.457	10.02	10.43	0.41	45
100 " " +200 " "	1.472		10.77		60
N/20 HCl	0.610		1.23		25
	1.493		11.73		20
	1.496		11.81		15
	1.505		11.90		15
N/20 NaOH	1.544		11.93		5
	0.488		6.00		25

Table 5 shows the values of the pH obtained by the use of the hydrogen electrode and of the quinhydrone electrode, and the difference between the readings, when solutions of clarified, unclarified, and fermented sugar juices are used.

Graph I shows the relation between the e.m.f. of the system, Al, BaO_2—HA—calomel and the pH of the solution HA. The points indicated by circles are points corresponding to the ordinary acid-base titration between

HCl and NaOH, while the points indicated by squares are points corresponding to the buffer solutions.



DISCUSSION OF RESULTS

For the present, except for the system Al—BaO_2, no attempt was made to follow the study of the different electrode combinations described. Experience has shown that extreme cleanliness is required for the proper workings of the other electrode combinations, a condition which prevents their use in ordinary industrial applications.

Since for sugar cane juices the main interest lies around pH = 8.8, the concentration generally considered for the best lime clarification, buffers and other solutions were selected to vary from around pH 6 to around pH 10.

Table 1 shows that the potential of the system using the Al—BaO_2 as an electrode may be easily duplicated. This is true when different Al—BaO_2 electrodes are used in the same solution, or when the same electrode is used many times in different buffer solutions of the same pH.

It was thought that previous immersion of the electrode in some neutral reagent might affect the time of equilibrium. Accordingly, some electrodes were immersed in water for 30 minutes before using, while the others were dried before use. Table 2 shows that there is no appreciable difference in the time of equilibrium for dried and wet electrodes.

If the potential of the normal calomel electrode is taken as +0.565 (at 25° C.), then the potential of the Al—BaO_2 electrode in the different pH solutions may be calculated. In table 6 this will be called $E_{obs.}$ On plotting $E_{obs.}$ against the pH, as in graph I, it may be seen that a straight line is obtained from pH 10.0 to around pH 7.0, which may be represented approximately by the equation,

$$E_{calc} = E_o - 5.05\ (0.06)\ pH \qquad (11)$$

where $E_o = 2.145$ *volts.*

TABLE 5

Values of the pH of sugar solutions as determined by the hydrogen and quinhydrone electrodes

HYDROGEN ELECTRODE	QUINHYDRONE ELECTRODE	DIFFERENCE	HYDROGEN ELECTRODE	QUINHYDRONE ELECTRODE	DIFFERENCE	HYDROGEN ELECTRODE	QUINHYDRONE ELECTRODE	DIFFERENCE	HYDROGEN ELECTRODE	QUINHYDRONE ELECTRODE	DIFFERENCE	HYDROGEN ELECTRODE	QUINHYDRONE ELECTRODE	DIFFERENCE
pH	*pH*	*pH*	*pH*	*pH*	*pH*	*pH*	*pH*	*pH*	*pH*	*pH*	*pH*	*pH*	*pH*	*pH*
6.27	6.62	0.33	7.91	8.26	0.35	8.49	8.78	0.29	9.28	9.53	0.25	10.71	10.36	−0.31
6.26	6.38	0.12	7.95	8.24	0.29	8.12	8.47	0.35	9.93	10.26	0.32	10.65	10.27	−0.38
6.60	6.76	0.16	7.58	7.76	0.20	8.66	8.88	0.22	9.59	9.88	0.29	10.93	10.40	−0.53
6.07	6.19	0.12	7.25	7.38	0.13	8.98	9.11	0.13	9.71	9 95	0.24	10.81	10 51	−0 30
6.28	6.42	0.14	7.24	7.43	0.19	8.35	8.49	0.13	9.01	9.22	0.20	10.65	10.39	−0.26
6.64	7.78	0.14	7.34	7.50	0.16	8.37	8.45	0.08	9.02	9.29	0.26	10.51	10.18	−0.33
6.74	6.83	0.09	7.38	7.52	0.14	8.85	9.02	0.17	9.16	9.35	0.19	10.88	10.36	−0.52
6.70	6.88	0.18	7.41	7.59	0.18	8.71	8.99	0.28	9.18	9.40	0.22	10.93	10.76	−0.17
6.55	6.67	0.12	7.68	7.77	0.09	8.44	8.56	0.12	9.23	9.48	0.25	10.66	10.54	−0.12
6.39	6.54	0.15	7.57	7.88	0.31	8.69	8.86	0.18	9.31	9.52	0.22	10.71	10.50	−0.21
			7.51	7.82	0.31	8.94	9.20	0.26						
			7.34	7.56	0.22	8.81	9.06	0.25						
			7.38	7.54	0.16									
Average		+0.12			+0.21			+0.20			+0.24			−0.31

From equation (11), knowing the pH of the solution, the value of E_{calc}, can be calculated. Table 6 gives a comparison of E_{obs}, and E_{calc}.

TABLE 6

Comparison of observed and calculated e. m. f. at the Al, BaO_2 electrode

pH	POTENTIAL OF CELL	E_{obs} OF HALF CELL	E_{calc} OF HALF CELL	$E_{obs}-E_{calc}$
10.0	1.464	–0.899	–0.855	–0.014
9.4	1.263	–0.698	–0.703	–0.005
9.0	1.145	–0.580	–0.582	–0.002
8.5	0.991	–0.426	–0.430	–0.004
8.1	0.887	–0.322	–0.309	+0.013
7.0	0.575	–0.010	–0.024	–0.014
6.0	0.495	+0.070	+0.327	–0.257

The last column in table 6 shows that at pH 6, the behavior of the Al—BaO_2 electrode is somewhat different.

Since from either equation (8b) or (9b),

$$E = E_o + 0.06 \log (H^+) \text{ at } 28^\circ \text{ C.} \qquad (12)$$

where E_o is a constant,

it is evident that the electrode potential as expressed in equation (11) does not exactly correspond to the assumptions made in the general theory. A further assumption must be made that the hydrogen ions of the solution are in some state of equilibrium with the hydrogen ions of the electrodes, the constant of equilibrium being

$$\frac{(H^+) \text{ solution}}{(H^+)^5 \text{ electrode}} = 1$$

Another method may be followed of determining whether the electrode under investigation follows the assumptions made in the theory, using equation (10). According to this equation, the potential of the cell Al, BaO_2—HA—H_2Pt is constant, irrespective of the value of the hydrogen-ion concentration in the solution. Table 3, however, indicates decidedly that equation (10) is not followed. More experiments are needed to settle this point.

Experiments have been made to determine whether the Al, BaO_2 electrode could be used for determining pH in sugar juices. The results in the present study, however, show that the potential readings in sugar solutions are very erratic. It may be pointed out in passing that if the sugar solutions are first clarified and then allowed to stand for many days, the potential varies with the pH, approximately, according to equation (11). However, if the potential reading is made just after clarification or after extraction from the cane, the readings become very erratic. Furthermore, it was observed that the electrode did not work when buffers containing some amino acids were used. It would seem, therefore, that proteins exert a poisoning influence on the Al, BaO_2 electrode.

When the problem, however, is that pertaining to ordinary acid-base titration, the Al, BaO_2 may be used with advantage. Table 4 shows the difference in pH obtained by the hydrogen electrode and the Al, BaO_2 electrode according to equation (11). It may be seen, especially in conjunction with the graph, that between pH 7 to pH 10, the error is small. Furthermore, even if the behavior of the electrode is not according to equation (11), when the pH of the solutions are outside the range, the two electrodes give the same e. m. f. at the common hydrogen-ion concentrations studied, as may be seen from the graph.

An electrode that may be used for sugar work is the quinhydrone electrode. Although La Mer and Parsons (1923) have shown its inadequacy for acid-base titrations when the pH is greater than 8, and Farnnell (1925) has pointed out its unreliability above the same pH, it was observed in the present work that the errors involved are comparable with the ordinary color method, provided readings are always made exactly one minute after addition of the quinhydrone to the solution. Table 5 shows the pH readings by the hydrogen and the quinhydrone electrode. It will be noted that while between pH 6 to pH 7 the average deviation of the quinhydrone electrode over the hydrogen electrode is about +0.1 pH, this difference increases to +0.2 pH between pH 7 to pH 10 and the −0.3 pH from pH 10 to pH 11. The great difference in readings that La Mer and Parsons observed in their work was not observed in this study so long as the precautions pointed out in this report were observed. For approximate work, therefore, where a difference of 0.2 pH is negligible, the quinhydrone electrode offers possibilities even at higher pH.

SUMMARY

1. Of the many different electrode combinations for non-gas electrodes studied, the Al, BaO_2 combination was found to offer some possibilities.

2. While the behavior of the Al, BaO_2 electrode does not conform very strictly with that corresponding to the theoretical assumptions for non-gas electrodes, it was found to give reproducible values of the e.m.f. when used in ordinary acid-base titrations or in buffer solutions containing no protein impurities; the optimum range under which this electrode works lies between pH 7 to pH 10. An empirical equation for calculating the pH from the observed e.m.f. at the electrode is given.

3. The Al, BaO_2 electrode can not be used for determining the pH of sugar juices. For this purpose, the quinhydrone electrode may be used up to pH 10, if certain precautions regarding the time of reading the potential of the cell, after the quinhydrone is mixed with the solution, are observed.

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EXTENSION DIVISION NOTES

Progressive Farm Spirit

On the recent trip to the province of Leyte by Professors Aldaba and Elayda, one of their important visits was made to Mr. Daniel Javier's farm "Camalig" in the barrio of Bugjo in the municipality of Abutog in the eastern part of Leyte. Accompanied by Mr. Mauro G. Rodriguez, Agricultural Extension Agent under the Bureau of Agriculture, stationed at Tacloban, Leyte, we were hospitably entertained by Mr. Javier in his farm house for about two days, and were shown all his activities on the farm. This is a new farm being developed on public land purchased by Mr. Javier from the government in accordance with the Philippine land laws. Only a portion of the tract has been cleared and brought into a state of cultivation. A sort of diversified farming is practiced by Mr. Javier; he has found this system of husbandry to be fairly well suited to his purpose. His plan is to put the whole area into tilth for a coconut plantation, making the work preparatory for this end pay for itself. A detailed account of the personal management of this farm by Mr. Javier will be given later on

Mr. Javier showed a keen interest in modern farming and in our agricultural and economic problems. Almost every waking hour of our stay was occupied in discussion of agricultural matters affecting his own enterprise and our country's agricultural situation in general. We sat up late into the night engaged in conversation on these topics. Mr. Javier is highly interested in the behavior of varieties of Philippine staples with regard to their profitable adaptation to different localities; in diversified cropping for a well-balanced agriculture as against specialized cropping; economical production as brought about by the different factors of production, such as more productive seed, maintenance of soil fertility by the application of green manuring and natural fertilizers, and labor-saving farm implements for planting, cultivation, and harvesting. The perplexing subject of marketing and market demand and prices that will give a profit commensurate with the farming outlay is a matter of interest to Mr. Javier. Also the keeping of farm records that enable the farmer to know more or less whether his farm business is a paying proposition or not, and the analysis of his farm practice so as to change and adjust his farming plan to the requirements of the time.

This discussion of agricultural topics certainly served as effective extension work. Mr. Javier was drawn closer to the College. Not a month has elapsed since our return from the Leyte trip that we have not been given a surprise by Mr. Javier. He came to the College Campus without

giving us warning. Apparently, he wanted to see how closely the farm practice we discussed with him on his Leyte farm is being followed on the College Farm and elsewhere. First of all, we took Mr. Javier on a drive through the province of Laguna to let him see the solid plantation of coconuts, bananas, rice, corn, sugar cane, and lanzon. These crops are all grown in Leyte, but in most cases not to the same extent as they are in Laguna. Except in some instances, coconut groves in Leyte are in small patches and only recently have plantations been laid out in big solid areas by replacing old abaca plantations or on extensive unoccupied areas. Banana plantations are also in small patches, and usually in house-yards. Lanzon trees in Leyte are found here and there mostly as specimen plants, and people have not as yet come to growing this fruit in continuous and extended plantations as in Paete and other Laguna towns. All told, Leyte is not behind Laguna in corn, rice, and sugar cane, except possibly in sugar cane. Sugar cane culture is almost negligible in the eastern part of Leyte, but considerable is raised in the western part, especially at Ormoc.

Returning to the College, Mr. Javier was shown the College Farm and farm methods by Professor Mariano B. Raymundo in charge of the College Farm Management course. Mr. Javier paid close attention to the following features on the College Farm:

1. Upland rice planting by a drilling machine and cultivation of drilled rice with a regular animal-drawn cultivator. By this method upland rice is set in uniform-distance rows which permits cultivation with an animal-drawn cultivator thus saving much in amount of seed and in dispensing with hand weeding and a good deal of hand labor.

2. Using the animal-drawn cultivator in corn and sugar cane field cultivation, instead of using the plow, a method never practiced in Leyte and not in vogue in the Islands. This practice prevents unnecessary destruction of roots and saves a considerable amount of time and labor, consequently lowering the cost of production.

3. Testing the newly introduced practice of growing lowland rice by direct planting of the seed in the permanent paddy. A late-maturing variety of rice is used, and is planted at the same time and treated at the beginning as is the upland rice. The field is not flooded. The rice stand is kept free from weeds with the use of the same cultivator as is used for upland rice. When the heavy rain comes the field is treated as a lowland rice field. It is flooded with either rain or with irrigation water. The habit of late maturing rice not being materially changed by this modified method, it is anticipated that it will give a positive result. In no other place in the Islands has this practice ever been tried. The probability of its becoming a more economical method than the usual one has made the experiment worth while trying.

4. For the practical and economical use of a tractor on the farm, the farmer himself must master the "ins and outs" of a proper handling of the

machine. With such knowledge on his part he can personally direct and supervise the working of a tractor when employing a tractor man, and it will thus prove an important factor in lowering farm expenses. It is expected that it will work that way whether the tractor is used as the principal motor power on the farm or as auxiliary to animal-drawn implements. The use of a tractor on the farm, however, is dependent upon the size of the farm, system of farming and management, farming outlook, and the amount of capital set aside for farm business. Above all, the farmer himself must live on the farm, run his farm operations, and study how to solve his own farm problems as related to the use of costly farm machines like a tractor.

5. Mr. Javier was shown that a blacksmith's shop is a necessary adjunct in keeping farm implements in working order and for durability and efficiency in doing the work. It may be a simple shop and except for the iron parts of it, most of the materials used in setting it up can be found on the farm, so are quite inexpensive.

6. Mr. Javier was shown that with the aid of the farm blacksmith, many of the imported farm machines, such as planters, row markers, cultivators, harrows, etc., were so adjusted and readjusted as to fit them for our local requirements in farm operations, so they can be used instead of hand labor thus saving time and energy.

7. He was shown the New College Copra Drier as it was built and operated on the College Farm. He was enthusiastic about it and hoped to introduce it in Leyte. Because of rainfall condition in that province, which is almost uniform throughout the year and practically no protracted dry season, this copra drier will save the farmers a lot of trouble in their copra drying. At present, their common practice is sun drying or in some cases the use of artificial heat drying by open air fire built on the surface of the ground below a bamboo trellis set up by bamboo poles in the air, on which the copra is spread. Either method is greatly interfered with by uncertain rainfall. Copra drying in Leyte in a copra drier, with a kiln dug out in the ground in about the same manner as the ordinary *tapahan* in Laguna, but with the difference that smoke is excluded from the copra, was found on one farm.

8. In the Animal Husbandry Department Mr. Javier was shown by Mr. Felix B. Sarao the entire procedure of making cottage cheese on the farm as an improvement upon the method used by native cheese makers in Laguna. The improvement in the College method consists in a more sanitary handling of the milk throughout the process, from the milking up to the packing of the cheese. In all the processes of the cheese making, care is taken not to touch with the operator's fingers the food material being handled. All utensils used in the operation are carefully washed with boiling water.

These are a few of the things that the College of Agriculture offers to our farming public by way of suggestions towards improving our farm

practice and farm economy. Every effort is made to adapt to actual practice on our farms what the College imparts to its students in the way of practical agricultural methods. This is a sort of an Extension demonstration, mainly given on the College Campus. Every farmer is welcome to it. And it is hoped that farmers of the type of Mr. Javier, a man up on the job—living on his farm and personally directing his farm work—will not only give the improvements they observe a fair trial on their farms, but will extend them to their neighbors once they prove them successful.

The Present "Granary" of the Philippines.

For a long time Pangasinan has been considered the "granary" of the Philippine Islands. But the province must now relinquish that honor to her sister province, Nueva Ecija. The sudden lead of Nueva Ecija in rice production which has given her the title that Pangasinan has held has been the subject of much discussion. The numerous factors that have contributed to so rapid an increase in production have been sought. Many factors must have contributed to produce such a great increase. The irrigation systems constructed by the Bureau of Public Works in some towns of Nueva Ecija and the intensive campaign for seed selection supposed to have been waged by the Bureau of Agriculture might have contributed considerably. But according to reliable information the greatest factor responsible for the increase is the recent very great influx of Ilocano labor into Nueva Ecija. This increase in population has resulted in an increase of rice acreage in the province. In these same years Pangasinan did nothing to restore its rice lands depleted through long years of cultivation without fertilization, and decreased its rice land area by converting it into sugar cane fields and coconut plantations. The increase of rice production in many towns of Nueva Ecija is really amazing. According to a personal investigation made by a graduate of the College of Agriculture, Mateo Jimenez, from Talavera, two towns, Cabanatuan and Guimba, produced more than a million cavans each in the 1925–26 crop. Cabanatuan with a population of 30,000 produced 1,390,000 cavans, and Guimba with a population of only 17,000 people produced 1,015,200 cavans.

Such an increase in production, especially of our staple food is a very encouraging sign from the agricultural standpoint. With towns with such small population producing a million cavans of rice a year it will not be long before we shall cease to import rice.

A Promising Farm Manager

Among the graduates employed by private concerns as farm managers the record of Irineo Maligaya of the class of 1925 is worthy of note. Just after graduation, Mr. Maligaya was employed as a farm manager by a wealthy *hacendero* in Negros. For two years he held that job with a very

commendable record. After two years of service he was allowed to take a two months' vacation in his home province. While on vacation he was offered position as manager of a farm in Nueva Ecija. The offer suited him well and he accepted it at once, with the agreement that he would be given a salary of ₱80 a month from date, October, but to be increased to ₱125 the following February. When the month of February came the owner being a man not wholly "on the square" wanted to evade the contract by making further promises to Maligaya as he thought that Maligaya would not leave him. But Maligaya insisted that the contract be kept or he would quit. His employer, appreciating the value of the services of Maligaya by the improvement he had made on his farm in the short time, decided he had better abide by the letter of the contract.

The farm on which Maligaya is working is a 1,000-hectare farm in Talavera, Nueva Ecija. It is a parcel of a 3,000-hectare farm owned by a rich family from Bulacan. The whole farm is managed by three men, one lot by Mr. Maligaya, another lot by Mr. Gregorio Francisco also a graduate of the College of Agriculture and with the distinction of being one of the few who holds the honorary degree of Master Farmer, and the third lot by an experienced farmer, though not with technical training. In this arrangement, the ability of Mr. Maligaya as a farm manager is being tested. In competition with two well-proven managers he will have to make very good. In spite of his few years of experience indications are that he will be able to keep up with his two colleagues and maintain the prestige of his college and make a name for himself as a farmer.

Co-operative Movement

It has been recently reported by the Department of Labor at Washington according to comment by *The Independent* in its June 25 issue that "Europe takes to co-operatives". According to the Department's own statistics there are 300,000 co-operative societies of all types that are functioning in Europe and an aggregate membership of 44,500,000 affiliated in them.

The most impressive feature of the movement is that it is not only producers who have organized co-operative societies but also consumers. "In twenty-two countries there are 50,000 consumer co-operative societies with a combined membership of 27,000,000 and annual sales of more than $5,500,000,000." The activities of these societies include manufacturing and wholesale selling. "In 1925 the wholesale business in twenty-one countries aggregated more than $800,000,000 and the value of goods produced in ten during the same year exceeded $200,000,000. The English Co-operative Wholesale Society is the largest manufacturer, trader and landowner in the United Kingdom."

The percentages of population reached through co-operative societies given for various countries are as follows-:

United Kingdom	45%
Denmark, Finland and Hungary	40%
France and Russia	30%
Belgium, Germany and Sweden	20%
Australia	6%
United States	2.5%
Argentina	1%

This means that Europe is changing the old methods of buying and selling as "barter and trade between individuals" to collective exchange through co-operative associations.

It may be said that in the Philippines organized co-operative effort is hardly begun among crop producers, and only in a very few instances have co-operative merchandise stores been set up to serve the buying interests of small isolated communities. The best known and largest co-operative effort that has been launched and shows promise is represented in the "Tuguegarao Tobacco Growers Association" at Tuguegarao, Cagayan Province. This association was organized by tobacco farmers under the leadership of an agent of the Bureau of Commerce and Industry with the object of strenghthening the bargaining power of the individual farmer with the collective effort of a co-operative association of farmers. It is also the object of this association to effect improvement in the financial condition of its members so as to enable them to improve the quality of tobacco they produce. Upon the initial success of this Association, tobacco farmers in other towns, such as Ilagan and Jones, Isabela, led by government agents have organized on about the same basis and for the same purpose as the Tuguegarao Association. Under private initiative and for a similar purpose tobacco growers at Bauang, La Union, have incorporated a Co-operative Association with a capital stock of ₱50,000 of which ₱26,000 is paid in. The last thing that was heard from this association was that its authorities have asked for the services of a competent government agent from the Bureau of Commerce and Industry to direct and push its co-operative activities.

That there is a demand for organized co-operative effort in the Philippines where economic pressure and narrow margin of living prevail among the inhabitants seems to be pointed out by the recent attempt of the Legislature through the Palarca bill on co-operatives "to provide legislation under which co-operative marketing associations may be established as stock associations." This attempt has been strongly indorsed by *The Tribune* (Manila daily newspaper) as a step in the right direction.

It may be asked, however, why not enact legislation in a more general way so as to include other types of co-operative societies, such as producer and consumer societies rather than limiting the provisions to co-operative marketing?

EXCHANGE NOTES

Any attempt to deal fundamentally with conditions of agriculture and country life must consider the existing status and efficacy of the rural elementary schools and their relations with any higher system of schools. The high standards attained in elementary education in Great Britain, France, Germany and earlier Poland, and some other countries in western Europe are matters of common knowledge. In large areas of continental Europe, however, especially in the eastern and southern countries, four rather serious shortcomings appear:

(1) Lack of any rural schools whatsoever. In parts of the Balkans, the two eastern provinces of Czechoslovakia, in large areas in Italy, Spain, and eastern Poland, elementary schools are not yet available to the children of farmers. In the eastern province of Czechoslovakia—a nation with peculiarly high educational ideals—there is 52 per cent illiteracy. It will doubtless yield to the efforts of this new and vigorous young republic, whose dominating purpose is expressed in its slogan "through culture to democracy". In eastern Poland there is 70 per cent illiteracy. It is under attack. Within six years 10,000 new rural elementary schools have been established and 35,000 teachers added. The government asserts that 40,000 additional schools are required for the 1,000,000 farm children yet unserved.

—*World Agriculture.*

There is a great demand for peanuts overseas. France and Great Britain are the largest importing countries, while the Netherlands, Belgium, and Italy also import fairly large quantities annually. We cannot, however, export peanuts profitably until the cost of production is reduced by the greater use of machinery and the production of larger yields per acre.

—*Journal of the Department of Agriculture*
(Union of South Africa).

There are still many muscovado sugar mills in the Philippine Islands. Some of them are quite up-to-date, have galvanized iron roofs on them and are from 60 to 80 feet long. We found one mill of the older type near San Fernando in which some people were living now after the mill stopped functioning. The place had a steam engine manufactured by Aitkin McNeil of Glasgow who sent many mills into the Islands years ago. All these mills have stone floors and they seem to be the landmarks of a departed glory in many sections on account of the coming of the centrals.

In Pangasinan, Philippine Islands, many muscovado mills still exist. Some of them use the Chattanooga mill made by the International Harvester Company. The Gonzales estate works up much cane in the primitive way. It originally had 26,800 acres which the French brought under subjection, but the Gonzales Sons have only 5,200 acres of it now. They use the caribou for transporting cane and they have the large clumsy carts with solid wood wheels which do the hauling. They plant the cane in checker-board fashion four feet apart and cultivate the cane with the caribou. Each mill employs from 15 to 20 men who get 80 centavos a day, though the boilers get 2 pesos a day. The season runs from 80 to 100 days a year.

—*The Planter and Sugar Manufacturer.*

As an indication of the value of agricultural extension work throughout the United States, the Experiment Station Record (Washington, D.C.) points out how the agricultural people themselves have taken hold to help develop this service, and how the taxpayers have willingly increased the support of this work.

In 1914 about $1,600,000 was spent for extension work by the federal and state governments, while in 1924 this had been increased to $19,394,000. Of this large amount, more than one-third (35 per cent) was paid by the county governments, 27 per cent by the state governments and 38 per cent by the federal government.

—*Extension Letter* (University of Hawaii).

Banana Trash.—There is a big problem here. It is stated, indeed, we think proved, that trash is the greatest carrier of Panama Diseases. The Laws regarding the use of trash are now very strict and will become stricter. It is the handiest packing material for bananas, or any product that we have. At present it should only be used to wrap bananas, and if taken out of a truck or waggon, and it touches the ground it must then be left to be burned. Even the burning is a problem, as when rain falls—and lately in most districts we have had three months of regular rains—the burning is difficult. The great point is the immense loss of fertility—the destruction of banana trash formerly taken back to the fields. How is to to be made up?

—*Journal Agricultural Society* (Jamaica).

COLLEGE AND ALUMNI NOTES

By request of the Executive Committee of the College of Agriculture, for a period of thirty days, from July 22 to August 22, in respect for our late Dean and as an expression of our sorrow for his death, all flags were at half-mast, bands of mourning on the sleeve or knots of black ribbon were worn by the faculty and the students. No gatherings of a social or recreational nature were held. Quiet prevailed on the Campus.

The large enrollment, 842, in the College this year made it obligatory to change the order which has been followed so long of mass Student Body meetings. Our Auditorium is far too small for so large a body to meet for transaction of business. The Student Body constitution was amended making possible the organization of a representative Student Council. This council is now the students' governing body. It is composed of ten representatives from each class and ten from the two preparatory classes combined. These representatives must receive credentials from the Secretary of the College on their scholastic records which must be up to a certain standard. The officers elected at the first meeting of the Student Body this College year are officers of this first Student Council. Marcelo Peña is president and Victoria Mendiola is secretary.

The first meeting of the Council was held August 7. President Peña made a strong appeal to the members to stand for the principles so long upheld by the Student Body and so long counselled by Dean Baker. His closing words were: "Fellow students, we must not only follow the spirit of the noble and wise injunction to 'stand solid for the right, always,' the last counsel of our beloved Dean, but we must so preserve and obey his lofty words of guidance that those who come to this College when we are gone shall be benefited by the high ideal our kind Dean wished all students here to have for their aim."

By invitation, Dr. R. B. Espino, head of the Department of Botany, was present and addressed the Council. The theme of his address was, that with the distinction of being chosen to represent a class came responsibility; and that the Council must be true to the traditional Los Baños Spirit which means: Loyalty to College, to country; honest and high scholarship; clean living; co-operation, fellowship, and good sportsmanship.

Standing and special committees were appointed and other business transacted.

With a record attendance the Los Baños Biological Club began its fifth year at a meeting held in the College Auditorium on July 28, 1927, at 7:30 in the evening. As in past years the meeting was open to the public. Discussion followed each paper. Dr. A. K. Gomez, president of the Club, was in the chair. The following papers were presented:

Experimental studies on the etiology of osteoporosis: I. The heritable nature of the disease.—By Dr. B. M. Gonzalez and Dr. Valente Villegas. Paper was read by Doctor Villegas.

Notes on larval trematodes from Philippine snails.—By Dr. M. A. Tubangui.

Studies on the correlation between grain and straw production of cowpeas.—By Mr. Pedro A. Rodrigo.

Mr. Rodrigo's paper was not presented owing to his illness.

Letters from Mr. Eleuterio Palisoc and Mr. Virgilio Pineda, both B. Agr. '27, and Mr. Cipriano Baroon, B. Agr. '26, were recently received by Professor Yule. Mr. Palisoc, who is Junior Agricultural assistant with the Bureau of Agriculture, Sandakan, British North Borneo, writes:

> I find my job immensely interesting and I am very glad that I accepted this position. I think you will be interested to know that all the employees of the Department of Forestry and Agriculture are Filipinos, with the exception of those occupying low salaried positions.

Mr. Pineda writes:

> My ranch (The Diamond P) lies thirty-five kilometers from the town of Cagayan. The automobile can go only as far as twelve kilometers of the way and the rest is a horse trail. . . . There are in my care about two hundred head of cattle. I am also engaged in farming and I believe that coffee will be my major crop. Of course I shall raise other crops to supply the household needs. Although we get excellent crops from rice and corn, I do not believe it will pay to go extensively into their production since the prime consideration here is the cost of transportation per unit weight. . . .
>
> It is good for those living on the plains of Bukidnon who have roads, but within our district the best automobile is the pony and the truck is the back of the carabao. I find also that in the ranch house I have to play the dual rôle of master and housewife. It looks funny but I like nice things in the home and in the absence of a feminine hand the masculine is a poor substitute. There are divers other rôles which a fellow must play on a ranch and farm combined.

Mr. Ciipriano Barbon, B. Agri. '26, writes that on November 14, 1926, he married Miss Caridad Mercado. He then resigned from his position as teacher in the Misamis High School and went to farming on Carinagan Farm.—To quote:

> At present I feel the dire need of capital. However, I manage to raise some chickens and pigs. I expect to have a hundred or more hens by January of next year. I now realize the value of a centavo. . . . The lot of the small farmer is hard indeed, but I would not exchange my present work for that of a salaried man receiving my former salary of ₱1,080 per annum.

New books and other publications added to the Library, College of Agriculture, from April 7 to August 4, 1927

Administrative code of the Philippine Islands. 1917.
Allen, James
As a man thinketh.
America, poems of
Fifty best poems of America.
Balzac, H. de
Christ in Flanders.
Barrie, James
A Tillyloss scandal.
Browning, E.
Sonnets from the Portuguese.
Browning, Robert
Pippa passes.
Browning, Robert
Poems.
Burns, Robert
Poems.
Church, F. J.
A trial of Socrates.
Coleridge, S. T.
The ancient mariner.
Dante Alighieri
Inferno, Vols. I and II.
Dumas, A.
Contesse de St. Germain.
Emerson, Ralph W.
Essays.
England, poems of
Fifty best poems of England.
Fitzgerald, E.
The Rubaiyat of Omar Khayyam.
Gilbert, B. Y. W. S.
The "Bob".
Hale, E. E.
The man without a country.
Hamilton & Kidner
Advising the tuberculous. 1926.
Iowa State Board of Education. Report, 1926.
Ibsen, Henrik
Ghosts.
Irving, Washington
Old Christmas.
Kew bulletin, p. 537–963. 1922.
Kipling, Rudyard
Barrack-room ballads.
Kipling, R.
Finest story in the world.
Kipling, R.
The man who was.
Kipling, Rudyard!
Vampire and other verses.

Kupfer, E.
Studies in plant regeneration. 1907.
Larmer, F. M.
Financing the live stock industry. 1926.
Lincoln, Abraham
Speeches and addresses of Abraham Lincoln.
Longfellow, H. W.
The courtship of Miles Standish.
Longfellow, H. W.
Hiawatha, Vols. I and II.
Macaulay, T. B.
Lays of ancient Rome.
Maeterlinck, M.
Pelleas and Melisande.
Mayo Foundation Lectures.
Lectures on nutrition, 1924–1925.
Poe, Edgar Allan
The murder in the Rue Morgue.
Poe, E. A.
The raven.
Shakespeare, W.
The comedy of errors.
Shakespeare, W.
Midsummer night's dream.
Shakespeare, W.
The tempest.
Shaw, Bernard G.
On going to church.
Sperlich, A.
Untersuchungen an blattgelenken, 1910.
Stevenson, R. L.
Will O' the mill.
Tennyson, A.
The coming of Arthur.
Tennyson, A.
The Holy Grail.
Tennyson, A.
Lancelot and Elaine.
Thoreau, H.
Friendship and other essays.
Turgenev, I.
Mumu and Kassyan of Fair Springs.
Waites, G.
New South Wales statistical register, 1924–25.
Washington, George.
Speeches and letters.
Webster, Knowlton, and Hazen
A teacher's manual accompanying the Webster, Knowlton and Hazen European History maps—ancient section. 1924.
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